

AD-A199 441

DOCUMENTATION PAGE

Form Approved  
OMB No. 0704-0188

2a. SECURITY CLASSIFICATION AND EXTENSION			1d. RESTRICTIVE MARKINGS		
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE			3. DISTRIBUTION/AVAILABILITY OF REPORT		
4. PERFORMING ORGANIZATION REPORT NUMBER(S)			5. MONITORING ORGANIZATION REPORT NUMBER(S)		
6a. NAME OF PERFORMING ORGANIZATION			7a. NAME OF MONITORING ORGANIZATION		
6b. OFFICE SYMBOL (if applicable)			7b. ADDRESS (City, State, and ZIP Code)		
8a. NAME OF FUNDING/SPONSORING ORGANIZATION			9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER		
8b. OFFICE SYMBOL (if applicable)			10. SOURCE OF FUNDING NUMBERS		
8c. ADDRESS (City, State, and ZIP Code)			PROGRAM ELEMENT NO.		
			PROJECT NO.		
			TASK NO.		
			WORK UNIT ACCESSION NO.		
11. TITLE (Include Security Classification)					
12. PERSONAL AUTHOR(S)					
13a. TYPE OF REPORT					
13b. TIME COVERED					
14. DATE OF REPORT (Year, Month, Day)					
15. PAGE COUNT					
16. SUPPLEMENTARY NOTATION					
17. COSATI CODES					
18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)					
19. ABSTRACT (Continue on reverse if necessary and identify by block number)					
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT					
21. ABSTRACT SECURITY CLASSIFICATION					
22a. NAME OF RESPONSIBLE INDIVIDUAL					
22b. TELEPHONE (Include Area Code)					
22c. OFFICE SYMBOL					

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

ARI Technical Report 787

19. Abstract (Continued)

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Research Report (RR) 1473

Research Products (RP) 88-04, 88-05, 88-06, 88-07, and 88-08

Research Notes (RN) 88-17 and 88-18



Accession For	
NTIS CRA&I	<input checked="checked" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

**Technical Report 787**

# **The Army Communications Objectives Measurement System (ACOMS): Survey Methods**

**Veronica F. Nieva and Michael D. Rhoads**  
Westat, Inc.

**Timothy W. Elig**  
U.S. Army Research Institute

**Editors**



**U.S. Army Research Institute  
for the Behavioral and Social Sciences**

**July 1988**

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Research accomplished under contract  
for the Department of the Army

Westat, Inc.

Technical review by

Curtis L. Gilroy  
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SECURITY CLASSIFICATION OF THIS PAGE

## REPORT DOCUMENTATION PAGE

Form Approved  
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION Unclassified			1b. RESTRICTIVE MARKINGS ---			
2a. SECURITY CLASSIFICATION AUTHORITY ---			3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited.			
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE ---						
4. PERFORMING ORGANIZATION REPORT NUMBER(S)  945269			5. MONITORING ORGANIZATION REPORT NUMBER(S)  ARI Technical Report 787			
6a. NAME OF PERFORMING ORGANIZATION  Westat, Inc.		6b. OFFICE SYMBOL (If applicable) ---	7a. NAME OF MONITORING ORGANIZATION U.S. Army Research Institute for the Behavioral and Social Sciences			
6c. ADDRESS (City, State, and ZIP Code)  1650 Research Blvd. Rockville, MD 20850			7b. ADDRESS (City, State, and ZIP Code)  5001 Eisenhower Avenue Alexandria, VA 22333-5600			
8a. NAME OF FUNDING/SPONSORING ORGANIZATION ---		8b. OFFICE SYMBOL (If applicable) ---	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER  MDA903-85-C-0414			
8c. ADDRESS (City, State, and ZIP Code)  ---			10. SOURCE OF FUNDING NUMBERS			
			PROGRAM ELEMENT NO. 6.37.31.A	PROJECT NO20263731 A792	TASK NO. 2.2.1	WORK UNIT ACCESSION NO. R.2
11. TITLE (Include Security Classification)  The Army Communications Objectives Measurement System (ACOMS): Survey Methods						
12. PERSONAL AUTHOR(S) Veronica F. Nieva and Michael D. Rhoads (Westat) and Timothy W. Elig (ARI), Editors						
13a. TYPE OF REPORT Final		13b. TIME COVERED FROM 86/10 TO 87/12		14. DATE OF REPORT (Year, Month, Day) 1988, July		
15. PAGE COUNT 90						
16. SUPPLEMENTARY NOTATION Timothy W. Elig and Michael E. Benedict were Contracting Officer's Representatives. Contract work was requested and funded by the Directorate of Program Analysis and Evaluation, U.S. Army Recruiting Command, Office of the Deputy Chief of Staff for Personnel.						
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)			
FIELD	GROUP	SUB-GROUP	Advertising Methodology Sampling ACOMS			
05	09	---	Army Questionnaire Telephone survey			
05	08	---	CATI Recruiting Weighting			
19. ABSTRACT (Continue on reverse if necessary and identify by block number) This report, the final in a series that documents various aspects of the Army Communications Objectives Measurement System (ACOMS), discusses the methodology used in the implementation of the ACOMS survey, a multiyear telephone survey of a nationally representative sample of 16- to 24-year-old American youth and their parents. Data were collected continuously throughout the year, using computer-assisted-telephone-interviewing (CATI) technology. The first chapter of this report presents an overview of the main elements of the ACOMS survey methodology: sampling and weighting, survey questionnaires, and data collection procedures. Each subsequent chapter presents further discussion of these topics. Chapter 2 discusses the characteristics of the various sample groups included in the survey, the sample selection procedures, the actual number of completed interviews for each major sample group, and the weighting procedures applied to the data. Chapter 3 describes the three survey instruments used: the household screening interview, the youth interview, and the parental (Continued)						
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input type="checkbox"/> UNCLASSIFIED/UNLIMITED <input checked="" type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION Unclassified			
22a. NAME OF RESPONSIBLE INDIVIDUAL Timothy W. Elig			22b. TELEPHONE (Include Area Code) 202/274-5610		22c. OFFICE SYMBOL PERI-RG	

## ARI Technical Report 787

## 19. Abstract (Continued)

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**The Army Communications Objectives  
Measurement System (ACOMS):  
Survey Methods**

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Department of the Army

July 1988

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Army Project Number  
2Q263731A792

Manpower and Personnel

Approved for public release; distribution unlimited.

## FOREWORD

The U.S. Army uses advertisements to affect the knowledge, attitudes, and behavioral intentions of youth and such significant influencers as parents to effectively recruit manpower. Army advertising development and execution is guided by a positioning statement and by specific, measurable objectives. This final report documents the methodology of the main survey conducted to measure the achievement of those objectives under the Army Communications Objectives Measurement System (ACOMS), which supports Army assessments of advertising program strategies and effectiveness. ACOMS also supports both planning for future strategy and increasing the operational efficiency of Army advertising programs.

ACOMS was developed to meet the needs of Army policy makers and operational managers through a cooperative effort with a Special Advisory Group (SAG) of representatives from the staffs of the Office of the Deputy Chief of Staff for Personnel, the U.S. Army Recruiting Command, the U.S. Army Reserve Officers' Training Corps (ROTC) Cadet Command, the Office of the Chief of the Army Reserve, and the Army National Guard. Funding was provided by the U.S. Army Recruiting Command with some funds also provided by the U.S. Army ROTC Cadet Command.

The participation of the U.S. Army Research Institute (ARI) in this cooperative effort was part of an on-going research program designed to enhance the quality of Army personnel. This work is an essential part of the mission of ARI's Manpower and Personnel Policy Research Group (MPPRG) to conduct research to improve the Army's capability to effectively and efficiently recruit its personnel. Specific efforts on ACOMS were undertaken at the direction of the Deputy Chief of Staff for Personnel (references: Message 2614317 NOV 84, subject: "Operation Image-Watchdog," and Memorandum for Record, ODCSPER, DAPE-ZXA, 3 Feb 86, subject: Army Communications Objectives Survey (ACOMS)). The survey results were briefed to the SAG at quarterly in-progress reviews and were also briefed in September 1987 and April 1988 to the Deputy Chief of Staff for Personnel, the Commander of the U.S. Army Recruiting Command, and the Chief of the Army Reserve.



EDGAR M. JOHNSON  
Technical Director



## ACKNOWLEDGMENTS

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Project Staff for the Period Reported (October 1986-December 1987)

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LTC Terry White (Chair) (ODCSPER); LTC Jesse Brokenburr, Gerald Klopp, CPT(P) Douglas McLiverty, CPT John Perry (USAREC); LTC Al Resnick, MAJ Thomas Loggie (USAROTCCC); LTC Rockwell, LTC Jesse Wall, MAJ Harry Simpson (OCAR); SGM Gene Wallace (ARNG); Zahava Joering, Michael Laurence, Vonda Kiplinger (DMDC); Paul Gade, Curtis Gilroy (ARI).

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## PREFACE

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This is the final report on the execution of the main data collection effort for Project Image Watch-Dog, "Army Communications Objectives Measurement System (ACOMS)." This project addressed the market for the personnel accessioning system that is responsible each year for obtaining from the non-prior-service youth market over 200,000 volunteers for the Army enlisted and warrant officer force. In addition, the U.S. Army Reserve Officers' Training Corps (ROTC) Cadet Command is responsible for attracting over 37,000 high-quality youth as college freshmen at 4-year colleges. To effectively recruit in the youth market, various components of the U.S. Army use advertisements to produce changes in the knowledge, attitudes, and behavioral intentions of youth and such significant influencers as peers and parents. ACOMS provides a measurement and analysis system to support Army

- (1) assessments of advertising program effectiveness;
- (2) assessments of advertising strategy efficiencies;
- (3) management of the advertising program; and
- (4) planning and development of new marketing strategies and segmentation.

The planning for this research was initiated in 1984. ACOMS developed out of work performed for a series of advertising effectiveness conferences directed by the U.S. Army Recruiting Command (USAREC) at the request of the Deputy Chief of Staff for Personnel. DCSPER, who met with the Commander of USAREC, the Chief of the Army Reserve, the Director of the Army National Guard, and the Deputy Chief of Staff of Training and Doctrine Command for ROTC in November 1984 to review the results of these conferences. These officers approved the mission requirements for ACOMS prepared by their staffs, as well as the basic research plan prepared by ARI. The DCSPER directed ARI to develop and monitor research plans and necessary contract efforts for ACOMS with guidance from a Special Advisory Group (SAG) from the involved Army offices. The Defense Manpower Data Center was added in a special technical advisory capacity before the first meeting of the SAG.

The SAG was intimately involved in refining the mission requirements for ACOMS throughout the procurement process that led to the selection in 1985 of Westat, Inc., as the ACOMS contractor. Scientists from Westat and the Army community, together with a multitude of advisors, developed and refined the research plans for the ACOMS Survey Design (Nieva & Elig, 1988) and the companion volume on the ACOMS Survey Analysis Plan (Gaertner & Elig, 1988). In addition to guidance from the SAG, plans for ACOMS benefited from advice concerning sampling, weighting, and estimation from a Statistical Advisory Panel.

TIMOTHY W. ELIG  
ARI Senior Scientist and COR

# THE ARMY COMMUNICATIONS OBJECTIVES MEASUREMENT SYSTEM (ACOMS): SURVEY METHODS

## EXECUTIVE SUMMARY

---

### Requirement:

To improve the efficiency and effectiveness of Army advertising communications.

### Procedure:

A national probability sample of American youth and their parents was interviewed from 13 October 1986 through December 1987, using computer-assisted-telephone-interviewing (CATI) technology. The Waksberg Random Digit Dialing (RDD) method was used to locate eligible youths, defined as noninstitutionalized 16- to 24-year-old youth, living in the contiguous 48 states, who have no prior military service or contractual commitment to serve in the military and who are not graduates of 4-year colleges. Attempts were made to interview all eligible male youth located and a subsample of female youth.

In response to concerns for fostering equal opportunity in the military, the ACOMS sample was designed to obtain a sample that would allow analysis of the major racial/ethnic groups, i.e., blacks and Hispanics. A supplementary sample of Hispanic males were interviewed to meet these goals. Since a sufficiently large sample of blacks was expected from the main sample, no black supplementation was conducted. In addition to the youth sample, which was the primary focus of the survey, interviews were conducted with a sample of parents of primary sample youth between 16 to 20 years of age.

Three survey instruments were used: a household screening interview designed to locate youth eligible for participation in the ACOMS survey; a youth interview; and a parental interview. All youth respondents were questioned regarding a variety of issues related to advertising and the enlistment decision process, e.g., their media habits, knowledge about various Army components, perceptions of Army attributes, and enlistment intentions and behaviors.

Based on listings of telephone numbers, monthly samples of youth and their parents were drawn. The data collection period for each monthly youth sample was 8 weeks, and data for their parents were collected up to 4 weeks after the youth interview. A large staff of trained interviewers conducted

interviews 7 days a week. Modifications were made incrementally to the data collection procedures to achieve desired sample sizes. Data collection procedures had stabilized by the fall 1987.

#### Findings:

Screening interviews of 106,419 households were conducted from October 1986 through December 1987; 13,197 youth interviews and 4,144 parental interviews were also conducted.

Household screenings were completed in 83% of sampled households. Interviews were completed with 76% of eligible youth identified and 61.5% of sampled parents.

All data were weighted up to the eligible U.S. population on a quarterly basis.

#### Utilization of Findings:

ACOMS data provide information useful to Army policy makers and organizations with operational responsibility to more effectively recruit in the youth market. ACOMS data provide the Army with the opportunity to examine questions and to develop policies key to the recruiting effort by using a nationally representative data base that was developed from state-of-the-art scientific methodology. ACOMS is being used for Army

- (1) assessments of advertising program effectiveness;
- (2) assessments of advertising strategy efficiencies;
- (3) management of the advertising program; and
- (4) planning and development of new marketing strategies and segmentations.

Based on ACOMS analyses, the Reserve Officers' Training Corps Cadet Command has changed the attributes to be emphasized in future marketing efforts for Army officers. In addition, the relative emphasis placed on Army attributes is being changed in advertising efforts for the enlisted force.

# THE ARMY COMMUNICATIONS OBJECTIVES MEASUREMENT SYSTEM (ACOMS): SURVEY METHODS

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# THE ARMY COMMUNICATIONS OBJECTIVES MEASUREMENT SYSTEM (ACOMS) SURVEY METHODOLOGY

## 1. INTRODUCTION

Veronica F. Nieva and Timothy W. Elig

The Army Communications Objectives Measurement System (ACOMS) survey was designed to provide timely information to Army policy-makers and advertising planners regarding key market responses to the Army's advertising programs. Survey data were collected continuously from a national probability sample of American youth and their parents during the period starting October 1986 until December 1987. Youth respondents were located using the Waksberg Random Digit Dialing (RDD) method. Interviews were conducted using computer assisted telephone interviewing (CATI) technology.

This report documents the methodology used in conducting the survey. Modifications from the original survey design that were implemented throughout the course of the survey and the rationale and results of such changes are also discussed. This report is one of a series that describes various aspects of the ACOMS project: the ACOMS Survey Design (Nieva and Elig, 1988); the ACOMS Analysis Plan (Gaertner and Elig, 1988); substantive analysis based on the data collected for the school year 1986/87 (Nieva, Gaertner, Elig and Benedict, 1988); a quarterly report series (Gaertner, Nieva, Elig and Benedict, 1988); and two volumes of supplementary tabulations for the enlisted and officer markets (Rhoads, Elig, McEntire, and Hoke, 1988).

The remainder of this introductory chapter provides an overview of ACOMS objectives and its major design elements. Chapter 2 describes the sample yields obtained in the ACOMS survey. Chapter 3 describes the content and structure of the youth and parental questionnaires. General descriptions of the types of questionnaire changes made over the course of the survey are included; however, for a detailed inventory of specific changes, the reader is referred to the ACOMS Users' Manuals (Westat, 1988). Chapter 4 discusses the preparation for and actual conduct of the data collection effort. Chapter 5 describes the weighting methodology, survey design effects, and estimation procedures used in the Acoms analyses.

### ACOMS Objectives

In an era when manpower experts are predicting increased difficulties for recruiting into military service, it becomes increasingly important for the U.S. Army to improve understanding and management of the factors that enable it to meet its manpower goals. Advertising communications represent one such factor.

Advertising is used extensively by the various Army components--the Active Army, the U.S. Army Reserve (USAR), the Army Reserve Officers' Training Corps (ROTC), and the Army National Guard (ARNG)--to induce changes in the knowledge, attitudes, and behaviors of youth

and their parents. Each year, the Army makes a sizable investment in the development and exposure of advertising communications intended to disseminate favorable Army images and to increase the enlistment propensity of eligible youth.

While in-house assessments have been conducted by the Army's main advertising contractor, and advertising has been touched upon by other youth surveys such as the Youth Attitude Tracking Survey (YATS), there had been no in-depth, independent examination of the effectiveness of Army communications prior to the ACOMS effort. ACOMS was designed to help the Army monitor and evaluate its advertising communications program and to provide ongoing measurement of the extent to which Army communications meet the communications objectives for different target groups.

The objectives of ACOMS were:

- (1) To support Army assessments of advertising program effectiveness in a timely fashion;
- (2) To support Army assessments of advertising strategy in an integrated framework; and
- (3) To support Army advertising management and planning for future strategy.

ACOMS was designed to monitor and assess the effectiveness of the Army's advertising communications program. A continuous survey data collection effort was designed to track changes over time in levels of advertising recall, and subsequent effects on the knowledge, attitudes, intentions, and actions of youth and their parents. Periodic analysis of key market responses could be reported to the Army decisionmakers and advertising planners in a timely fashion.

The second and third goals for ACOMS involved the use of ACOMS data to assess the Army's advertising strategy and to support management and planning for future strategy. ACOMS survey data included an integrated set of indicators that were intended to be influenced by Army advertising, i.e., youth and parental recall of Army advertisements, knowledge of Army offers, perceptions about the Army, and enlistment related intentions and behaviors. At any one point in time, assessments of Army advertising could be conducted by analysis of these indicators. In addition, a longitudinal survey was designed to be part of ACOMS to further the understanding of the lagged and cumulative effects of advertising and of the relationships between advertising and other factors that influence the eventual enlistment decision.

Thus, ACOMS was intended to contribute to the development of behavioral and economic models of enlistment decisionmaking currently being developed by the Army Research Institute. As better models of the enlistment decision process are developed, more effective marketing strategies can be applied to help the Army attain its annual recruiting goals.

The targeting of advertising to the Army's recruiting market segments was another aspect of advertising strategy that is supported by ACOMS survey data. Analysis of reactions to advertising, media habits, attitudes, and other variables by major demographic segments of interest and regions can refine the definitions of the Army's major market segments or identify and validate new market segments.

ACOMS survey data were also intended to support development of the Army's advertising strategy by allowing analyses on brand differentiation ("brands" referring to various Army components or the different military services). Youth perceptions of various Army or military "brands" would be useful in examining brand differentiation at several levels: differentiation among the active Army, Reserve, National Guard, and ROTC attributes; differentiation between the Army and other services' attributes; and differentiation between the Army's position and distinctive advantages vis-a-vis civilian alternatives (i.e., college and civilian employment). This information helps the Army make decisions on relative emphasis of various communications about different attributes and offers of the Army components.

Finally, development of advertising strategy was supported by a separate ACOMS data collection effort. Mall intercept interviews were collected in order to examine the extent to which the Army's intended messages are actually exposed to, and perceived by, their target audiences. Description of this element of ACOMS is presented in Baxter and Gay (1988).

#### The ACOMS Survey Overview

The continuous survey of American youth and their parents constituted the core of ACOMS. As noted above, the survey was designed to support all of the ACOMS project objectives. This section presents an overview of the major survey elements. Further detail on how the survey was actually conducted is presented in Chapters 2 to 5 of this report.

#### The ACOMS Sample

National probability samples of American youth and their parents were interviewed from 13 October 1986 through December 1987, using computer assisted telephone interviewing (CATI) technology. The Waksberg Random Digit Dialing (RDD) method was used to locate eligible youths, defined as non-institutionalized 16- to 24-year-old youth, living in the contiguous 48 states with no prior military service nor contractual commitment to serve in the military, and who are not graduates of four-year colleges.

Attempts were made to interview all eligible male youth located and a subsample of female youth. Thus, the first important distinction made in the youth sample was gender. The sample was also designed to be sensitive to educational categorizations, because of the Army's interest in recruiting Tier 1 youth, i.e., youth with

regular high school diplomas or youth with at least one semester of college credit. The ACOMS Primary sample (PS) consisted of male (Primary Male Sample, or PMS) and female (Primary Female Sample, or PFS) youth in the Tier 1 priority group. The ACOMS Secondary sample (SS) consisted of youth who were holders of Adult Basic Education (ABE) or General Educational Development (GED) certificates, or youth who did not complete high school, did not have an ABE or GED, and were not enrolled in regular high school or college. These youth are also referred to as Tier 2 and Tier 3 youth in the military's system of educational priorities. Males in these categories are referred to as the Secondary Male sample (SMS) and females as the Secondary Female sample (SFS).

In response to concerns for fostering equal opportunity in the military, the ACOMS sample was designed to obtain a sample that would allow analysis of the major racial/ethnic groups, i.e., Blacks and Hispanics. A supplementary sample of Hispanic males was interviewed in order to meet these goals. Since a sufficiently large sample of Blacks was expected from the main sample, no Black supplementation was conducted.

In addition to the youth sample, which was the primary focus of the survey, interviews were conducted with a sample of parents of primary sample youth between 16 to 20 years of age. Parents were of interest in large part because of their potential influence on the military enlistment decisions of their sons and daughters. They were also perceived as a potential direct target for Army advertising.

Initial sample yields were lower than expected. Thus, modifications were made incrementally to the survey procedures in order to achieve desired sample sizes. Sample yield goals had been reached by the fall of 1986. Details of the sample and modifications made to improve yield are presented in Chapter 2.

#### The ACOMS Survey Instruments

Three survey instruments were used: a household screening interview designed to locate youth eligible for participation in the ACOMS survey; a youth interview; and a parental interview.

All youth respondents were questioned regarding a variety of issues related to advertising and the enlistment decision process, e.g., their media habits, knowledge about various Army components, perceptions of Army attributes and enlistment intentions and behaviors. The large numbers of content domains included in the survey instrument had to be balanced by pragmatic concerns for respondent burden, necessitating a complex instrument with extensive branching and allocation of questions to subpopulations of respondents.

The parental survey instrument largely paralleled the youth instrument in both form and content. Details on the survey instruments are included in Chapter 3.

### The ACOMS Survey Data Collection

Survey data were collected from 13 October 1986 through December 1987. CATI technology was used to interview monthly samples of youth and their parents. The Waksberg RDD method was used to locate households with eligible youth. In addition to the youth and parents in the main sample, a supplementary Hispanic male sample was drawn, applying the RDD method to a sample of telephone exchanges known to have high Hispanic density.

The data collection period for each monthly youth sample was eight weeks, and data for their parents were collected up to four weeks after the youth interview. A large staff of trained interviewers conducted interviews seven days a week.

Chapter 4 describes the survey data collection effort.

### The ACOMS Sample Weighting, Design Effects and Analysis Methodology

In order to achieve desired sample sizes of respondents in different subgroups, ACOMS youth and parental respondents were selected with differing probabilities of selection. This deviation from simple random sampling (SRS) procedures necessitated the development of sample weights in order to produce unbiased estimates of ACOMS population parameters. Further, the departure from an SRS design, while improving the effectiveness of data collection, had some costs in terms of sample efficiency. This relative efficiency is called the sample "design effect." A final implication of the complex sample design is the need to use appropriate tests of statistical significance. ACOMS analyses used two primary approaches for testing statistical significance: approximate chi-square statistics and the balanced repeated replication (BRR) methodology.

Chapter 5 describes the sample design effects and the methodology used for sample weighting and estimation.

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## 2. ACOMS SURVEY SAMPLE

Leyla Mohadjer and Veronica F. Nieva

The Army Communications Objectives Measurement Survey (ACOMS) required the design and implementation of a major survey aimed at evaluating the effectiveness of Army advertising communications over time. Several changes were made to the original basic and optional samples, given in the Statement of Work (SOW), as a result of a series of meetings with the ACOMS Special Advisory Group (SAG) and the statistical external panel. Most changes involved sample reductions in response to SAG priorities and budgetary concerns. The decisions to make these changes were reached on the basis of a series of studies that investigated the cost and benefit of each of the basic and optional samples. Refer to the ACOMS Survey Design (Nieva & Elig, 1988) for information about the original design requirements and the studies. The ACOMS sample design incorporated these revised requirements.

### Sample Design Overview

#### Respondent Universe

Youth sample. The main respondent universe for this survey consisted of eligible youth in households with telephones in the 48 contiguous states. Eligibility was defined in terms of age and service in the military, as described below. The universe of eligible youth was divided further by gender and educational categories. The major youth sample groups were:

- (1) Primary Male Sample (PMS): 16- to 24-year-old males who were in the Army's Tier 1 priority group, i.e., those who were in high school or who were high school diploma (HSD) graduates but not graduates of four-year colleges, excluding in-service and prior-service population. The PMS definition also excluded youth with General Education Diploma/Adult Basic Education (GED/ABE), or any other "nonregular" certificate of high school completion.
- (2) Secondary Male Sample (SMS): 16- to 24-year-old males who were in the Army's Tiers 2 and 3, i.e., those who were not in high school and who did not have an HSD, excluding in-service and prior-service population. The SMS sample included males with GED/ABE or other "non-regular" certificate of high school completion.
- (3) Female Sample (FS), comprising Primary (PFS) and Secondary (SFS) samples, with similar definitions as given for the male samples.

Parental sample. The respondent universe also included parents of the sampled PMS and PFS who were 16- to 20-years of age.

### Sample Selection

The Waksberg Random Digit Dial (RDD) procedure. The sample was selected using the "modified" Waksberg Random Digit Dialing (RDD) procedure. This method provides an unbiased representative sample of eligible persons in households with telephones in a way that minimizes the number of out-of-scope telephone numbers that had to be screened. Essentially, the modified Waksberg RDD procedure involves two steps: first, "household cluster identification" (identifying and selecting a sample of blocks of 100 numbers called "telephone clusters," which contain working, residential telephone numbers); and second, dialing random numbers within the clusters to locate households of eligible respondents.

The ACOMS sampling frame consisted of the most recent AT&T tape containing all existing telephone area codes and existing exchanges. The frame was updated every six months. Details of the procedures for RDD sample selection are described in Waksberg (1978) and in the ACOMS Survey Design report (Nieva & Elig, 1988).

For each telephone number contacted within the household clusters, a brief screening interview was conducted in order to determine (a) whether the number was located in a business or household and, if in a household, (b) whether youth meeting the necessary criteria for inclusion in the study were members of the household. Any member of the household over the age of 16 was eligible to respond to the screener questions.

If youth meeting the criteria for selection were identified, attempts were made to complete those interviews within the eight week field period for that set of telephone numbers. All male youth and about one-fifth of the female youth who met the ACOMS eligibility criteria were selected for the full interview. An additional four weeks from the time of the completed youth interview was allowed for the completion of an interview with the parental sample.

Sample size goals. Annual sample size targets for various subgroups of interest were established in the SOW. As noted previously, the main group of interest was the Army's Tier 1 male group, otherwise referred to as the Primary Male Sample (PMS). No specific targets were set in the SOW for the Tier 2 and 3 males, otherwise referred to as the Secondary Male Sample (SMS). This group was considered a "convenience" sample, and the targets were defined as the number of such youth who were located in the households with PMS youth.

The SOW also set target sample sizes for other groups of interest: females, youth, black males, Hispanic males, and PMS enrolled in two and four year colleges. Table 1 shows the original target sample sizes as well as revised targets established after changing the definition of the PMS and SMS groups. The PMS was originally defined as those youth who were in school or high school graduates but not 4 year college graduates. After the start of the study, it was decided that the PMS should exclude not-in-school youth



Table 1

Original and Revised Annual Target Number of Respondents

Subpopulation	Old Target	Revised <u>New</u> Target <sup>a</sup>
Primary Male Sample (PMS)	9,603	9,300
Female Sample (FS)	1,953	1,953
Black	1,200	1,162
Hispanic	970	970
Secondary Male Sample (SMS)	850	1,153
Total males	10,753	10,753
Total youth	12,706	12,706

<sup>a</sup>New targets established Summer of 1986 in clarification that General (GED) and (ABE) students are SMS, not PMS

with non-traditional certificates of high school completion, such as GED or ABE. Excluding GED/ABE from the definition of PMS reduced the size of the PMS by approximately 3% (i.e., approximately, 3% of the total eligible youth had a GED/ABE, or some other "non-regular" certificate of high school completion).

Table 2 shows the estimated number of telephone clusters, numbers, and households necessary to yield the required sample sizes for the various groups of interest. Estimates were based on population data (e.g., 1980 census information on population distribution, school enrollment and educational attainment, extrapolated to 1986, data on the percent of youth with prior service, by age and race), estimates of response rates, and assumptions on how these factors interact, e.g., that the response rate would be the same in all Brigade regions and for all ages, and that there would be no differential telephone coverage problems for sample subgroups. Response rate estimates were based on a combined screener and main interview response rate of about 80%, as stipulated by the statement of work. The assumed combined response rate was broken down into its two components: 95% for the household screener and 85% for the main interview. A more detailed discussion of these assumptions is provided in the ACOMS Survey Design (Nieva & Elig, 1988).

Households screened for PMS youth were expected to yield the required sample sizes for these other population groups of interest, with the exception of Hispanic male youth. In order to obtain the required sample numbers of this relatively rare group, a supplemental sample was drawn from telephone exchanges known to have high Hispanic density.

Hispanic supplement. The Hispanic supplement was drawn using a data tape of telephone exchanges and their associated demographic characteristics on the 1980 Census, developed by the Donnelley Marketing Information Services. The tape was used to identify exchanges with heavy concentrations of Hispanics. Telephone exchanges in the First, Fifth, and Sixth Recruiting brigades with heavy concentration of Hispanics were identified and oversampled. Within these exchanges, the same RDD procedures used for the main sample were applied.

Parental selection. One parent in each household with PMS or PFS youth between the ages of 16 and 20 was selected for interview. For a randomly chosen half of the households with a 16- to-20-year-old PMS/PFS youth, the eligible parent was female; for the other half, the parent was male. Only one parental interview was conducted within a single household. Parental respondents were selected for the parental interview in a three-stage process. First, prior to any household contact, the CATI system randomly designated the gender of any potential parent respondent. The second stage occurred following completion of the screener in households with at least one eligible youth. At this point, one youth was selected randomly from all 16- to 20-year-old PMS or PFS youth in the household to be the "target" of the parental interview. The youth selected at this point were designated as the "parental-linked sample."

Table 2

Annual Estimated Sample Sizes for Telephone Clusters, Numbers,  
and Households

	Main Sample N	Hispanic Supplement N	Total N
Telephone Clusters	2,400	192	2,592
Telephone Numbers	120,000	11,064	131,064
Identified Households	70,000	6,638	76,638
Screened Households	66,500	6,306	72,806

In the third stage, the appropriate parental respondent was identified by the parental-linked youth. In the demographic and parental location modules of the youth interview, potential parental influencer(s) of the predesignated gender were enumerated. Youth who lived with a stepparent or guardian were prompted to choose from among their (a) natural or adoptive parent, (b) stepparent, or (c) guardian, depending on their perceptions of their most influential parental figure. The parental influencer was not required to live in the same household to be interviewed.

#### Youth Sample Yields

Study objectives required careful control of the sample sizes for a variety of population subgroups. Careful monitoring of sample yields was necessary to detect, early on, whether assumptions underlying the sample design would hold. Care was necessary since some assumptions were based on data from the 1980 Census Bureau that were seven years old, and some data required to refine the sampling plan (e.g., prior service estimates and coverage differences for youth with different education and prior-service status) were not available for planning purposes.

Tables 3 to 6 show the major data collection statistics monitored regularly for the youth sample, i.e., sample sizes (telephone clusters, numbers, household screener interviews, and eligible youth identified and interviewed) and ratios obtained between key elements of the sampling plan (residency rates, response rates for households and youth, and household screener to youth respondent eligibility ratios). Table 3 shows the planned and actual quarterly sample sizes, while Table 4 shows planned and actual ratios relevant to sample performance. Tables 5 and 6 parallel Tables 3 and 4, but show monthly figures rather than quarterly.

It should be noted that all of these statistics are reported according to sample cohorts rather than date of interview. After monthly samples of telephone numbers were drawn, eligible youth identified were available for interviews for a period of eight weeks. Thus, sample statistics based on sample cohorts, such as those reported in Tables 3 to 6, do not resemble statistics based on date of interview, such as those reported in the ACOMS Quarterly Reports (Gaertner, Nieva, Elig, & Benedict, 1988).

The first quarter of data collection (Fall 1986) shown in Table 3 fell considerably short of expectations. The shortfall was detectable at all stages of the survey process--the number of household screeners completed (17,258) was 95% of the original plan; and overall, the number of youth interviews completed (2083) was only 66% of plan.

Table 3

Data Collection Sample Sizes by Quarterly Sample Cohort<sup>a</sup>

	Original Quarterly Plan <sup>b</sup>	Quarterly Sample Cohort					Total
		Fall 86	Winter 87	Spring 87	Summer 87	Fall 87	
Telephone Clusters	648	648	648	808	948	1,008	4,060
Telephone Numbers	32,766	32,766	32,766	40,766	47,766	50,766	204,830
Household Screeners	18,168	17,258	16,601	21,439	24,044	27,077	106,419
Total Youth Eligibles <sup>c</sup>	3,725	2,829	2,731	3,604	3,843	4,361	17,368
Primary Male Sample [PMS]	2,825	2,006	1,945	2,565	2,778	3,062	12,356
Secondary Male Sample [SMS]	250	310	290	374	434	516	1,924
Female Sample [FS] <sup>d</sup>	575	513	474	665	631	784	3,067
Black Male [PMS & SMS]	353	239	200	272	326	393	1,430
Hispanic Male [PMS & SMS] <sup>e</sup>	285	253	245	355	323	350	1,526
Total Youth Interviewed <sup>c</sup>	3,166	2,083	2,089	2,824	2,943	3,258	13,197
Primary Male Sample [PMS]	2,400	1,498	1,516	2,044	2,179	2,329	9,566
Secondary Male Sample [SMS]	212	214	209	260	289	344	1,316
Female Sample [FS] <sup>d</sup>	488	371	363	520	475	585	2,314
Black Male [PMS & SMS]	300	184	155	207	241	282	1,069
Hispanic Male [PMS & SMS] <sup>e</sup>	243	186	191	283	231	245	1,136

<sup>a</sup>All numbers in these tables include the basic sample and the Hispanic supplement.<sup>b</sup>Original plan, presented in the ACONS Survey Design, sets an annual PMS goal of 9,600 plus the Hispanic supplement.<sup>c</sup>"Total youth" consists of the sum of PMS, SMS, FS, and the Hispanic supplement. Black and Hispanic males are included in the PMS & SMS.<sup>d</sup>Females are randomly subsampled at a 20% rate.<sup>e</sup>Includes main sample and supplement.

Table 4

## Data Collection Ratios by Quarterly Sample Cohort

	Original Quarterly Plan	Quarterly Sample Cohort					Total
		Fall 86	Winter 87	Spring 87	Summer 87	Fall 87	
Residency Rate (in percentages)	60.0%	62.6%	62.8%	62.5%	61.8%	63.4%	62.6%
Household Screener Response Rate (in percentages)	95.0%	84.1%	80.7%	84.1%	82.6%	84.1%	83.0%
Total Youth Eligibility Ratio (No. of households to 1 eligible)	4.9:1	6.1	6.1	6.0	6.3	6.2	6.1
Primary Male Sample [PMS]	5.9:1	8.6	8.5	8.4	8.7	8.8	8.6
Secondary Male Sample [SMS]	66.5:1	55.7	57.2	57.3	55.4	52.5	55.3
Female Sample [FS]	5.4:1	6.7	7.0	6.4	7.6	6.9	6.9
Black Male [PMS & SMS]	47.1:1	72.2	83.0	78.8	73.8	68.9	74.4
Hispanic Male [PMS & SMS] <sup>a</sup>	58.3:1	68.2	67.8	60.4	74.4	77.4	69.7
Total Youth Response Rate (in percentages)	85.0%	73.6	76.5	78.4	76.6	74.7	76.0
Primary Male Sample [PMS]	85.0%	74.7	77.9	79.7	78.4	76.0	77.4
Secondary Male Sample [SMS]	85.0	69.0	72.1	69.5	66.6	66.7	68.4
Female Sample [FS]	85.0	72.3	76.6	78.2	75.3	74.6	75.4
Black Male [PMS & SMS]	85.0	77.0	77.5	76.1	73.9	71.8	74.8
Hispanic Male [PMS & SMS]	85.0	73.5	78.0	79.7	71.5	70.0	74.4
Combined Household x Total Youth Response Rate (in percentages)	80.0%	61.9	61.7	65.9	63.3	62.8	63.1

<sup>a</sup>Hispanic male eligibility ratio is derived from the combination of the basic sample and the Hispanic supplement from areas with high Hispanic density. Therefore, this ratio does not represent expectations from the nationwide population.

Table 5

Monthly Data Collection Totals<sup>a</sup>

	Original Monthly Plan <sup>b</sup>	Monthly Sample Cohorts										
		Oct 86	Nov 86	Dec 86	Jan 87	Feb 87	Mar 87	Apr 87	May 87	Jun 87		
Telephone Numbers	10,922	10,922	10,922	10,922	10,922	10,922	10,922	12,922	12,922	14,922		
Household Screeners	5,542	5,678	5,687	5,893	5,228	5,688	5,685	7,123	6,731	7,585		
Total Youth Eligibles <sup>c</sup>		916	927	827	913	896	922	1,243	1,083	1,278		
Primary Male Sample [PMS]	942	637	649	700	671	611	663	840	793	932		
Secondary Male Sample [SMS]	83	118	86	106	84	109	107	152	109	113		
Female Sample [FS] <sup>d</sup>	192	161	172	180	158	176	152	251	181	233		
Black Male [PMS & SMS]	118	77	61	101	66	62	72	101	83	88		
Hispanic Male [PMS & SMS] <sup>e</sup>	95	84	96	73	107	62	76	123	102	130		
Total Youth Interviewed <sup>f</sup>	1,033	678	657	748	663	710	716	1,018	819	987		
Primary Male Sample [PMS]	800	477	476	545	498	490	528	688	627	729		
Secondary Male Sample [SMS]	71	80	60	74	55	75	79	122	67	71		
Female Sample [FS] <sup>d</sup>	163	121	121	129	110	144	109	208	125	187		
Black Male [PMS & SMS]	100	60	40	84	44	56	55	86	56	65		
Hispanic Male [PMS & SMS] <sup>e</sup>	81	65	62	59	80	50	61	104	78	101		

<sup>a</sup> All numbers in these tables include the basic sample and the Hispanic supplement.<sup>b</sup> Original plan, presented in the ACOMS Survey Design, sets an annual PMS goal of 9,600 plus the Hispanic supplement.<sup>c</sup> "Total youth" consists of the sum of PMS, SMS, FS, and the Hispanic supplement. Black and Hispanic males are included in the PMS & SMS.<sup>d</sup> Females are randomly subsampled at a 20% rate.<sup>e</sup> Includes main sample and supplement.

Table 5 (continued)

	Jul 87	Aug 87	Sep 87	Oct 87	Nov 87	Dec 87	Total
Telephone Numbers	15,922	15,922	15,922	16,922	16,922	16,922	204,830
Household Screeners	8,014	7,798	8,232	9,191	9,053	8,833	106,419
Total Youth Eligibles	1,313	1,280	1,250	1,449	1,439	1,473	17,368
Primary Male Sample [PMS]	953	923	902	1,017	993	1,052	12,356
Secondary Male Sample [SMS]	131	144	159	170	190	155	1,923
Female Sample [FS]	229	213	189	262	256	266	3,067
Black Male [PMS & SMS]	116	116	94	127	132	134	1,430
Hispanic Male [PMS & SMS]	100	107	116	91	124	135	1,526
Total Youth Interviewed	1,010	968	965	1,091	1,111	1,056	13,197
Primary Male Sample [PMS]	763	706	710	785	779	765	9,566
Secondary Male Sample [SMS]	82	100	107	113	132	99	1,316
Female Sample [FS]	165	162	148	193	200	192	2,314
Black Male [PMS & SMS]	89	88	64	92	104	86	1,069
Hispanic Male [PMS & SMS]	67	81	83	61	93	91	1,136



Table 6

## Monthly Data Collection Ratios

	Original Monthly Plan	Monthly Sample Cohorts										
		Oct 86	Nov 86	Dec 86	Jan 87	Feb 87	Mar 87	Apr 87	May 87	Jun 87		
Residency Rate	60.0	60.2	63.0	64.7	61.4	62.7	64.1	65.3	61.6	61.0		
Household Response Rate	95.0	86.4	82.8	83.5	78.0	82.3	81.2	84.5	84.6	83.4		
Total Youth Eligibility Ratio	4.6	6.2	6.1	6.0	5.7	6.4	6.2	5.7	6.2	5.8		
Primary Male Sample [PMS]	5.9	8.9	8.5	8.4	7.8	9.3	8.6	8.5	8.5	8.1		
Secondary Male Sample [SMS]	66.5	48.1	66.1	55.6	62.2	57.5	53.1	46.9	61.8	67.1		
Female Sample [FS]	5.4	35.3	33.1	32.7	33.1	34.7	37.4	28.4	37.2	32.6		
Black Male [PMS & SMS]	47.1	73.7	93.2	58.3	79.2	91.7	79.0	70.5	81.1	86.2		
Hispanic Male [PMS & SMS] <sup>a</sup>	58.3	67.6	59.2	80.7	48.9	91.7	74.8	57.9	66.0	58.4		
Total Youth Response Rate	85.0	74.0	70.9	75.9	72.6	79.2	77.9	81.9	75.6	77.2		
Primary Male Sample [PMS]	85.0	74.9	71.2	77.9	74.2	80.2	79.6	81.9	79.1	78.2		
Secondary Male Sample [SMS]	85.0	67.8	69.8	69.8	65.5	75.8	80.2	80.3	61.5	62.8		
Female Sample [FS]	85.0	75.2	70.3	17.7	69.6	87.8	71.7	82.8	69.1	80.3		
Black Male [PMS & SMS]	85.0	77.9	65.6	83.2	66.7	90.3	76.4	85.1	67.5	73.9		
Hispanic Male [PMS & SMS]	85.0	77.4	64.6	80.8	74.8	80.6	80.3	84.6	76.5	77.7		
Combined Household x Total Youth Response Rate	80.0	63.9	58.7	63.4	56.7	65.2	63.3	69.2	64.0	64.4		

<sup>a</sup>Hispanic male eligibility ratio is derived from the combination of the basic sample and the Hispanic supplement from areas with high Hispanic density. Therefore, this ratio does not represent expectations from the nationwide population.

Table 6 (continued)

	Jul 87	Aug 87	Sep 87	Oct 87	Nov 87	Dec 87	Total
Residency Rate	61.9	62.1	61.3	64.1	62.4	63.7	
Household Response Rate	81.3	78.9	85.3	84.8	85.7	81.9	83.0
Total Youth Eligibility Ratio	6.1	6.1	6.7	6.3	6.3	6.0	6.1
Primary Male Sample [PHS]	8.4	8.5	9.2	9.0	9.1	8.4	8.6
Secondary Male Sample [SMS]	61.2	54.2	52.3	54.1	47.6	57.0	55.4
Female Sample [FS]	35.0	36.6	44.0	35.1	35.4	33.2	34.7
Black Male [PHS & SMS]	69.1	67.2	88.5	72.4	68.6	65.9	74.5
Hispanic Male [PHS & SMS]	80.1	72.9	71.8	101.0	73.0	65.4	69.8
Total Youth Response Rate	76.9	75.6	77.2	75.3	77.2	71.7	76.0
Primary Male Sample [PHS]	80.1	76.5	78.7	77.2	78.4	72.7	77.4
Secondary Male Sample [SMS]	62.6	69.4	67.3	66.5	69.5	63.9	68.4
Female Sample [FS]	72.1	76.1	78.3	73.7	78.1	72.2	75.4
Black Male [PHS & SMS]	76.7	75.9	68.1	72.4	78.8	64.2	74.8
Hispanic Male [PHS & SMS]	67.0	69.2	71.6	67.0	75.0	67.4	74.4
Combined Household x Total Youth Response Rate	62.5	59.6	65.9	63.9	66.2	58.7	63.1

The shortfall in the number of households screened was critical because it ultimately restricted the size of the pool from which youths could be identified and interviewed. The difference from plan was due to the difference between the obtained household response rate (84.1%) and the household response rate assumed in the original plan (95%). In retrospect, the assumption of a 95% household response rate was an overoptimistic base for realistic planning. The project statement of work required an overall 80% response rate. Plans to achieve this overall response rate further assumed that the household screener response rate would be 95%, and that the youth response rate would be 85%.<sup>1</sup>

In addition to the household shortfalls due to response rates, youth sample yields suffered from two other major factors: fewer youth met the eligibility criteria than anticipated, and response rates for the extended youth interview were lower than planned.

The eligibility ratio for each major youth group was defined in terms of the ratio between the number of households successfully screened and the number of youth identified who met the criteria for inclusion. The sampling plan expected an overall youth eligibility ratio of 4.9 households to 1 youth identified, and a PMS eligibility ratio of 5.9 households to 1 PMS identified. In the first quarter of data collection the overall youth eligibility ratio obtained was 6.1 households to 1; for PMS, it was 8.6 households to 1. The number of youth eligibles located in the first quarter (N=2,829) was only 76% of plan, with a somewhat larger shortfall for the Primary Male Sample (71% of plan). Planned and actual eligibility rates for various youth subgroups are shown in Table 4.

A number of factors could potentially explain shortfalls in eligibility ratios, although no definitive information was available to reach firm conclusions. They include: parental gatekeeping (i.e., parents who did not enumerate eligible youth in order to avoid further participation in the survey); lower screener response rates among households with PMS youth than other households; and telephone undercoverage, particularly among older youths (i.e., 21- to 24-year-old youth).

The only group for which there was no serious eligibility problems was the Secondary Male Sample, which had a much higher eligibility rate than expected. In part, this could be attributed to the changes made in eligibility criteria in the Spring 1987 quarter which moved ABE and GED high school completions from the PMS to the SMS group.

Sample yield was affected, not only by the household response rate and the youth eligibility ratio, but also by the youth response

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<sup>1</sup>The household screener response rate was defined as the number of household screeners completed divided by the number of households identified. The youth response rate was defined as the number of youth interviewed divided by the number of youth identified.

rates. The youth response rate obtained in the first quarter was 74%, lower than the expected level of 85%. While this response rate, like that obtained for household interviews, was good and comparable to those obtained by similar studies such as the Youth Attitude Tracking Survey, Phase III (78.8%), it was lower than the optimistic rate stipulated by the original statement of work, which was used as the basis for designing the sampling and data collection plan.

#### Modifications to Improve Youth Sample Yields

A series of incremental measures were therefore undertaken to improve both eligibility and response rates. Four types of modifications were undertaken: (a) changes in household screener wording; (b) optimizing interviewer staffing patterns by day of the week and time of day; (c) changes in eligibility determination procedures; and (d) increasing the sample of telephone numbers contacted per month. The first two modifications were conducted just prior to the start of the second quarter of data collection. The last two modifications were started at the beginning of the third quarter, although the increase in telephone numbers sampled continued incrementally until the fall of 1987. Each of these modifications and their effects are discussed below.

Household screener changes. Since the majority of the refusals to the household screener occurred at the start of the interview, the introduction was seen as a critical factor for keeping the respondent on the telephone. The following wording change was made to allay respondent apprehension about the sponsorship and content of the interview.

#### Original Version

Hello, this is (Interviewer Name).  
I am calling from Westat, a research firm near Washington, D.C.  
We are conducting an important national survey for the U.S.  
Government.

#### Revised Version

Hello, this is (Interviewer Name).  
I am calling from Westat, a research firm near Washington, D.C.  
We are conducting a study for the United States Government  
about people's plans for the future and their reaction to Armed  
Forces advertising.

A second change to the screening interview was made in response to interviewer feedback that some parental respondents appeared to be giving inaccurate information on household composition in order to avoid participating in the study. The household composition question was therefore revised to diffuse the focus from the specific population of interest. The change in wording is shown below.

### Original Version

Since the survey we are conducting for the U.S. government is concerned with the career plans of young adults, we need to know how many young adults live in your household. Including anyone away on vacation, away on business or living away at school, how many young people between the ages of 13 and 24 live in your household?

### Revised Version

We have a few questions to see if anyone in your household will be included in this study. Including yourself...

how many people aged 25 or older live in your household?

how many people between the ages of 13 and 24 live in your household?

Interviewer staffing changes. Changes to the interviewer staffing patterns were made at the same time as the screener modifications. Observation of interviewing productivity showed variations according to time of day and day of week. For example, weekday mornings were less productive than other times for youth interviews. Staffing levels were therefore adjusted such that the interviewing workload coincided with the most productive periods.

The results of both of these changes can be seen by comparing the response and eligibility rates of the first and second quarters of data collection. Table 4 shows no major improvements between the first and second quarters in the screener response rates, youth eligibles located and interviews completed. Household and youth response rates for the second quarter were 81% and 76%, respectively, compared to 84% and 74% obtained in the first quarter. Youth eligibility ratios also remained essentially stable between the first and second quarters, indicating that the modifications to the screener did not uncover any more eligibles than those previously reported. It appeared, therefore, that other modifications to the survey procedures would be necessary in order to obtain the desired youth sample sizes.

Eligibility determination changes. At the start of the third quarter (April 1987), another change was made in order to improve the youth eligibility rates. During the first two quarters of data collection, youth were excluded from the main interview if the household screener respondent refused to answer or did not know the answer to any questions that determined eligibility for the survey. Since many screener respondents could not answer questions regarding the education and military experience of all youth in the household, it was possible that some eligible youth were being excluded from participation. For the third quarter, therefore, the final determination of youth eligibility was postponed until the beginning of the

main youth interview, when the youth was asked all the questions that determined eligibility. These questions were not asked again during the main interview if the youth was the household screener respondent.

These procedural changes did not result in the anticipated increases in the number of eligible youth. In the first and second quarters of data collection, 6.1 households were needed to locate 1 eligible youth. After the procedural changes were implemented, 8.6 and 8.5 households were needed to locate 1 Primary Male Sample youth in the first and second quarters, respectively. The eligibility ratios obtained were not much different. The overall youth eligibility rate remained close to the 6.1 to 1 ratio obtained in the first two quarters (6.0 to 1; 6.3 to 1; and 6.2 to one for the third, fourth, and fifth quarters, respectively). Eligibility ratios for other youth groups also showed no major improvements.

PMS eligibility ratios also remained stable. In the third, fourth, and fifth quarters, respectively, 8.4, 8.7, and 8.8 households were needed to locate 1 PMS youth. These ratios were very similar to the first and second quarter ratios.

Increasing the number of telephone numbers per month. Since the response rates for both the household and youth interviews were relatively stable over time (see Tables 4 and 6) and were very similar to response rates obtained in comparable youth surveys such as the Youth Attitude Tracking Survey we did not feel that the sample yield could be improved substantially by further efforts to improve response rates. In addition, it appeared that the eligibility ratios being obtained could also be expected to remain stable for the duration of the study.

It therefore appeared prudent to enlarge the pool of telephone numbers from which respondents could be obtained. The number of telephone numbers in the monthly sample was increased at the start of the third quarter by 2,000, from 10,922 to 12,922.

The increase in monthly telephone numbers contacted resulted in the expected gains in obtained sample sizes, although the gains were not as yet sufficient to reach the monthly sample sizes desired. Therefore, the process of increasing the number of telephone numbers contacted monthly continued incrementally under close scrutiny for yield and cost implications. Increases in the sample of telephone numbers were managed without corresponding cost increases by continuing to adjust interviewer staffing patterns to optimize productivity.

In June 1987, the monthly sample of telephone numbers was again increased by 2,000, and an additional 1,000 numbers were added in July and again in October, bringing the monthly sample of telephone numbers to 16,922. At this level, it was felt that the annual sample size targets could be obtained for the year starting in the fall of 1987.

### Youth Data Collection Summary

As expected, growing experience with the management of a monthly sampling and data collection effort showed steady improvement in data collection yields as time progressed. Shortfalls experienced at the start of the tracking survey effort in the fall of 1986 gradually decreased so that sample size targets were being met by the fall of 1987. These improvements were largely due to the increase in the sample of monthly telephone numbers contacted each month. The pool was gradually increased without a corresponding increase in interviewer hours, although staffing patterns were carefully monitored by day of the week and time of day.

As discussed previously, various other measures taken to increase the obtained youth sample size did not result in major improvements.

Future surveys of similar populations can be expected to experience similar eligibility and response rates found in the ACOMS survey. Fairly large differences were obtained between the estimates derived largely from 1980 Census statistics (projected to 1986), suggesting that real population shifts may have occurred in the interim. In addition, it is possible that telephone coverage may also have declined somewhat during this period.

By the fall of 1987, the data collection effort had reached a stable state, with expectations for meeting most sample size goals in the upcoming school year. Table 7 shows the sample size targets and data collection projections for school year 1987/88, using the distributions of youth obtained in the fall quarter. As noted earlier, sample size targets for all major sample groups were expected to be achieved or exceeded in the upcoming year.

### Parental Sample

The parental sample consisted of fathers and mothers of 16- to 20-year-old Primary Sample youth. One parent in each household with PMS or PFS youth was selected for interview. As described more fully in Chapter 3, the gender of the parent to be interviewed was predetermined at the household level by the CATI program. In cases where multiple parental figures of the appropriate gender were available (e.g., stepfathers and fathers), the designation of the specific parental figure to be interviewed was determined by the youth respondent.

Table 8 shows the parental sample sizes and response rates by quarter. A total of 4,144 parents of primary sample youth were interviewed. Although half of the households were designated for fathers and half for mothers, response rate differences between the fathers (54.5%) and mothers (68.9%), resulted in a greater number of mothers interviewed (Table 8). It should be noted that the parental response rate reported is a very conservative estimate since the denominator includes parents who could not be located for various reasons (e.g., diseased parents, parents for whom no complete names

Table 7

Data Collection Projections for the 1987/88 School Year (SY 87/88)

	Target <sup>a</sup>	Expected SY 87/88
<u>Basic Sample</u>		
Primary Male Sample [PMS]	9,300	9,300
Secondary Male Sample [SMS]	1,153	1,239
Total Males	10,453	10,539
Black	1,162	1,012
Hispanic	650	801
Total Females	1,953	2,232
<u>Hispanic Supplement</u>	300	300
<u>Total Youth</u>	12,706	13,071

<sup>a</sup>New targets established in Summer 1986 in reclassifying ABE & GED students as SMS, not PMS.



Table 8

Parental Sample Sizes and Response Rates by Quarterly Sample Cohort<sup>a</sup>

	Quarterly Sample Cohort					Total
	Fall 86	Winter 87	Spring 87	Summer 87	Fall 87	
Parents Identified	1,065	1,068	1,474	1,547	1,581	6,735
Mothers	505	519	736	762	770	3,292
Fathers	560	549	738	785	811	3,443
Parents Interviewed	668	635	898	955	988	4,144
Mothers	342	347	499	537	542	2,267
Fathers	326	288	399	418	446	1,877
Parental Response Rate	62.7	59.5	60.9	61.7	62.5	61.5
Mothers' Response Rate	67.7	66.9	67.8	70.4	70.4	68.9
Fathers' Response Rate	58.2	52.5	54.1	53.2	55.0	54.5

<sup>a</sup>Response rate =  $\frac{\text{Completed Interviews}}{\text{Completed interviews + refusals + unfinalized cases + nonlocatables}}$

and/or telephone numbers were obtained from the youth respondent). Non-locatable parents consisted of approximately 20% of the parental sample identified.

Relatively few changes were made to the procedures for collecting data from the parental sample. After the first three quarters, efforts were made to improve the parental response rates by providing special interviewer training. Some youth were perceived as performing a "gatekeeper" function for their parents, refusing outright to allow contact with their parents or refusing to provide adequate information to enable parental contact. Interviewers were trained in techniques of converting the youth's refusals by explaining the importance of allowing the parent to make his/her own decision to be interviewed. Some youth were also concerned about the confidentiality of the information they provided. Interviewers were able to obtain additional parental names after assuring the youth of the confidentiality of their responses and explaining the content of the parental questionnaire. However, no major response rate improvements appeared to result from these efforts.

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### 3. ACOMS SURVEY INSTRUMENTS

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The Army Communications Objectives Measurement System (ACOMS) includes three survey instruments: (a) the household screener, (b) the youth questionnaire, and (c) the parent questionnaire. The content and structure of each are described in this chapter. In addition, major changes made to each instrument are also discussed

#### The Household Screener

The household screener was a three-minute instrument designed to locate eligible respondents for the full ACOMS interview. Using the Random Digit Dialing (RDD) method of sample selection, telephone numbers were contacted at random. The screener interview was used to identify and eliminate nonhousehold telephone numbers such as businesses and institutional telephone numbers as well as households that did not have youth who fulfilled ACOMS eligibility requirements.

The screener interview was conducted with any knowledgeable household member who was obviously not a young child. If the screener respondent did not know key information such as the number of youth in the household, the respondent was asked to call another household member to the phone. If no one else was available, an appointment was made to call the household at a time when a knowledgeable household member was likely to be home. Screener respondents were often youth eligible for the ACOMS interview. In such cases, after completion of the screener instrument, the respondent was guided directly into the main youth interview. Otherwise, appointments were made for each youth eligible for the main interview.

The screener began with verification and identification of the telephone number. The interviewer verified the telephone number, identified him/herself, and asked several questions designed to screen out business telephone numbers. The screener then inquired about the number of youth between 16 and 24 years of age who currently live in the household. If the telephone number was dialed incorrectly, if the number was a business, or if the household did not contain an age-eligible youth, the interviewer read a brief statement of thanks for the respondent's time and terminated the interview.

In households with age-eligible youth, the interviewer read a Privacy Act statement that guaranteed confidentiality of responses and notified the respondent that participation was voluntary. In addition, a more detailed description of the purpose and sponsor of the study was presented. Following this explanation, information on the names and ages of the age-eligible youth was solicited. In all households, this information was requested for all age-eligible males. Parallel information for age-eligible females was only collected in a random 20% of all households which were pre-designated as potentially available for female interviews.

Once all desired youth were enumerated, the interviewer asked a series of questions on the youth's educational attainment and military service record. Answers to these questions were used to assess the youth's eligibility for participation in the ACOMS survey. Questions were also asked to clarify whether the youth was currently living in that household or in a college dormitory or boarding school. In the latter case, a phone number where the youth could be reached during the school year was obtained. The race, last name, and county of residence for each desired youth enumerated were then collected.

#### Elimination of 13- to 15-Year-Old Tracking Information

During the first two quarters of ACOMS data collection, tracking information was collected for 13- to 15-year-olds identified during the screening interview. The information was originally collected as a cost-saving mechanism, accompanying an earlier iteration of the sample design. It was proposed then that longitudinal and cross-sectional samples could possibly be combined as a way of reducing sample size requirements. Under such conditions, it would have been possible to save screening costs substantially by "pre-identifying" youth who would enter the sample in subsequent years.

However, the final sampling design calling for a "fresh" cross-sectional sample each year minimized the potential savings from the "pre-identified" youth. Later design changes that limited the longitudinal sample to 16- to 20-year-old youth further diminished the utility of collecting information on the 13- to 15-year-old youth. These considerations, combined with the Army's concern about potential public sensitivity to collecting information on youth below the recruiting market age-boundaries led to a decision to discontinue the enumeration and tracking of 13- to 15-year-old youth beginning July 1, 1987.

#### The Youth Interview

##### The Hierarchy of Effects Model

The main Army Communications Objectives Measurement System (ACOMS) survey instruments consisted of youth and parental questionnaires based on a modified hierarchy of effects model (Fishbein & Ajzen, 1975) of the advertising process (see Figure 1.). Implicit in the model was the notion that (a) the consumer gains awareness of a product through advertising messages, which result in (b) beliefs about the product, in interaction with the consumer's evaluation of his/her need for the product, which in turn affect (c) the respondent's attitude toward the product, and (d) subsequent intentions and actions toward the product. The model therefore suggested the major types of criteria by which ACOMS assessed advertising effectiveness:

- (1) Awareness (or recall) of Army advertisements;
- (2) Positive beliefs or perceptions about Army attributes;

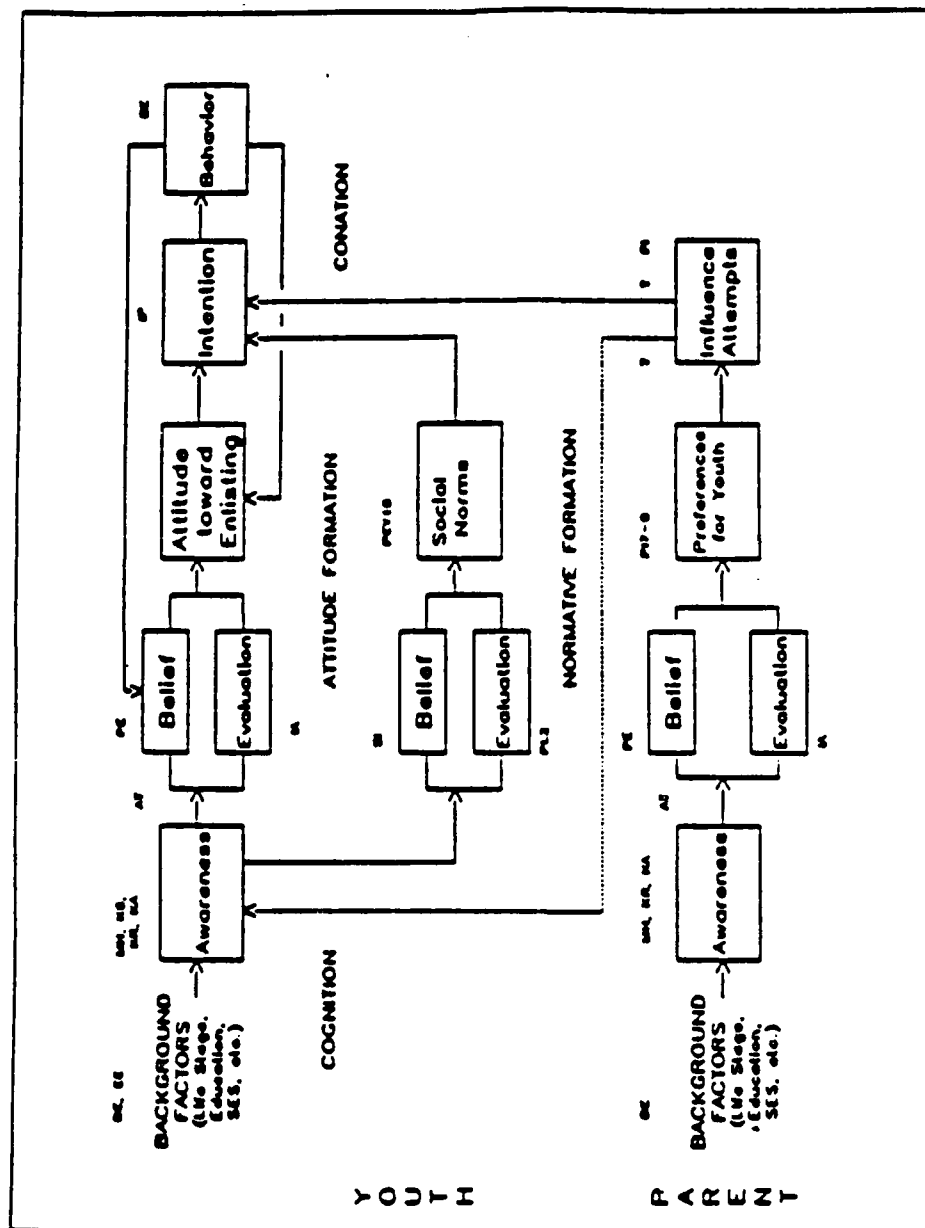


Figure 1. Expanded Fishbein-Azjen hierarchy of effects model for ACOMS.

(3) Positive attitudes toward Army enlistment, intentions to enlist; and

(4) Actual enlistment-related behaviors.

The model also posited the impact of social influence on the youth's intentions to enlist. Social norms, in general, and the youth's parents, in particular, were seen as significant factors in the youth's attraction to the Army.

Parental attitudes and behaviors were hypothesized to be affected by Army advertising, in a process that paralleled that of the youth. According to the model, parents, like the youth, became aware of the Army through its advertising. If effective, such advertising changes their beliefs and attitudes towards the Army in a more positive direction. Positive parental attitudes were then expected to be manifested in parental behaviors intended to influence the youth's intention to enlist.

In the current context, the hierarchy of effects model suggested important measures for consideration in measuring the effects of Army advertising. Respondent demographics (e.g., region, race and ethnicity, and sex), life stage (e.g., age, employment and marital status, income or income of household, and education), media habits and exposure were postulated to affect respondent awareness of the Army gained through exposure to Army advertising. This level of knowledge was hypothesized to affect respondent beliefs about advertising messages such as attributes of the Army. In Fishbein and Azjen's model as adapted, these beliefs took the form of agreement that a given attribute was offered by the Army (or component, other service, college or civilian job).

Corresponding to these beliefs were evaluations of the importance of these attributes to the respondent. The youth's attitudes toward enlistment were hypothesized to be the product of beliefs about what the Army offers and the corresponding personal importance of those attributes. Thus, attitudes would be positive when the respondent believed that positively evaluated outcomes relating to military service were likely. They would be indifferent when perceived outcomes were not seen as important, or when important positive outcomes seen as only moderately likely. Finally, attitudes were expected to be negative when negatively evaluated outcomes were seen as likely.

These attitudes were hypothesized, in turn, to affect behavioral intentions including propensity toward the Army, which then were expected to affect behaviors. It is important to note that these actions may include enlistment, but are also likely to include intermediate actions like seeking information, asking for advice, seeing a recruiter, and so on. As the model suggests, these intermediate actions could feed back on beliefs and evaluations.

The model also included the effects of social (especially parental) influence on the decision process. Parents of a subset of ACOMS respondents were interviewed on their exposure to Army advertising, and beliefs and evaluations of Army attributes. The parents were also asked preferences for the target youth's future and how the parents attempted to influence the youth's planning.

#### Youth Interview Structure

The youth interviews, which averaged about 30 minutes in length, provide the major measures of the dynamics and effects of Army advertising available in ACOMS. In accordance with the conceptual model which has guided the development of ACOMS, the youth interview was divided into 14 topical modules. In order to achieve a 30-minute average interview while ensuring that all necessary information is obtained, a complex questionnaire structure was developed. The 14 questionnaire modules were divided into 8 "core" modules which were asked of all respondents, and 6 "noncore" modules which were asked either of a randomly selected subset of respondents, or of respondents with defined characteristics determined earlier in the interview.

Core modules. The core modules were:

- (1) Education and Employment: elicited employment history and measures of course-content and school performance useful for assessing quality.
- (2) Intentions and Propensity: asked for the respondent's plans for the next few years, constructed to parallel and supplement measures of Army propensity in the Youth Attitude Tracking Study II (YATS II) (Research Triangle Institute, 1985).
- (3) Behaviors: elicited information on the respondent's activities relative to enlistment, employment and/or college enrollment.
- (4) Importance of Attributes: assessed the importance to the respondent of attributes defined by the Army's communications objectives. These items corresponded to the evaluation component of the Hierarchy of Effects model.
- (5) Knowledge-Recall: asked for unaided and aided recall of Army (by component) and other service advertising, presented in random order. The respondent was also asked where the advertising was seen or heard, what its main message was, and whether he/she believed and/or liked it.
- (6) Attitude toward Army Advertising: ascertained how much the youth liked and believed the advertisements he/she had seen or heard.



- (7) Perceptions/Beliefs: asked whether the Army (by component), other services, military service in general, college and civilian employment offered the attributes defined by the Army's communications objectives presented in random order. These items corresponded to beliefs in the Hierarchy of Effects model.
- (8) Demographics: elicited information on respondent's ethnicity, marital status, Social Security number, socioeconomic background, and current address. Demographic data was used for weighting purposes, and for analytic comparisons of subgroups.

It should be noted that one of the core modules, Perceptions/Beliefs about the Army and other career options, was divided into sections that were assigned to respondent subgroups differentiated by educational status and plans. These allocation strategies are discussed in further detail later in this chapter.

Non-core modules. Non-core modules were asked only of particular respondents. The non-core modules were:

- (1) Media Habits: elicited information on the amounts of television, radio, and print material the respondent is regularly exposed to, and his/her favorite programs and print vehicles (asked only of a randomly selected half of all youth respondents).
- (2) Knowledge-Slogan Recognition: asked whether the respondent could identify slogans utilized in Army, other services and joint-service advertising presented in random order (asked only of a randomly selected half of all youth respondents).
- (3) Knowledge-Awareness: asked for the respondent's level of knowledge concerning Army offers (asked only of a randomly selected half of all youth respondents).
- (4) Parental-Location Information: elicited information required to contact parents (asked only of parental-linked youth sample).
- (5) Social Influences: asked for the respondent's assessments of the attitudes of friends, parents and others toward enlistment (asked only of the parental-linked youth sample).
- (6) Tracking Information: elicited information required to trace youth selected for inclusion in the longitudinal sample, including anticipated changes in telephone number, names and phone numbers of employer and two others likely

to know respondent's whereabouts (asked only of longitudinal sample).<sup>2</sup>

The Slogan Recognition, Knowledge-Awareness, and Media Habits modules were asked of only a randomly selected half of all youth respondents and each possible pair of modules was asked of one-sixth of the sample. Slogan Recognition, Knowledge-Awareness and Media Habits modules were distributed among respondents as shown in Table 9.

Respondents were randomly assigned to each of these three modules with a probability of .333. Half were not assigned a second module from this group of three. The remaining half received one of the two remaining modules with equal probability.

Table 9

Module Rotation Plan: Percentage of Youth Respondents Assigned to Modules

	Second Module			None	Percentage
	Media Habits	Slogan Recognition	Knowledge-Awareness		
Media Habits	0.0%	8.3%	8.3%	16.7%	33.3%
Slogan Recognition	8.3%	0.0%	8.3%	16.7%	33.3%
Knowledge-Awareness	8.3%	8.3%	0.0%	16.7%	33.3%
Percentage	16.7%	16.7%	16.7%	50%	

Allocation of the Perceptions/Beliefs sections. The Perceptions/Beliefs module contained questions about those attributes which constituted the major copy points, or communications objectives, of Army advertising. These communications objectives were developed in an iterative process that involved group and individual discussions with Special Advisory Group (SAG) members and other Army representatives.

<sup>2</sup>Originally, plans included a longitudinal sub-sample of youth, who were to be reinterviewed at annual intervals. This subsample was later dropped from the project.

ACOMS respondents were asked whether these attributes were descriptive of 10 referents (active Army, Reserve Officers' Training Corps (ROTC), Army National Guard (ARNG), U.S. Army Reserve (USAR), Navy, Marines, Air Force, military service generally, college, and work) that may be perceived by the youth as future career options. Table 10 shows the attributes asked about each of the service and career referents.

The attributes listed for each referent was considered a "section" in the Perceptions module. Since asking any single individual to respond to all 10 sections would have been an intolerable burden to the respondent, a plan to allocate respondents to Perceptions sections was devised in collaboration with the SAG.

The allocation scheme was intended to reflect the market priorities of each of the Army components. Respondents were divided into six subsamples:

- (1) Those who have completed three or more years of college;
- (2) Respondents currently enrolled in first or second year of college;
- (3) High school students intending to go to college.
- (4) High school students not intending to go to college;
- (5) High school diploma graduates not currently enrolled in college; and
- (6) High school noncompleters.

The specific rules of the allocation scheme are described below:

- (1) All respondents were asked about two components, usually active Army and one other. However, one group (college-bound high school students) was asked three modules.
- (2) All Primary Male Analytic Sample/Primary Female Analytic Sample (PMAS/PFAS) eligibles were asked the active Army perceptions questions (Groups 2 through 5).
- (3) Those attaining three or more years of college (Group 1) were asked two sets of questions, those pertaining to ROTC and one other component, branch, college, or civilian job.
- (4) College freshmen and sophomores (Group 2) were asked two modules, either active Army, or ROTC, and one other. One-third of Group 2 was asked active Army, and ROTC, one-third active Army and one other module, and one-third ROTC, and one other module.

Table 10

## Allocation of Q87-2 Perceptions to Service and Career Options

Attributes	Army				Air Force	Marines
	Army	Reserves	National Guard			
A wide variety of opportunities to find a job you can enjoy	X	X	X		X	X
A physically challenging environment	X				X	X
An experience you can be proud of	X	X	X		X	X
An advantage over going right from high school to college	X				X	X
An opportunity to develop leadership skills	X	X	X		X	X
The chance to work with the latest high-tech equipment	X				X	X
A great value in your civilian career development	X	X	X		X	X
An excellent opportunity to develop self confidence	X	X	X		X	X
The opportunity to develop your potential	X	X	X		X	X

Table 10

## Allocation of Q87-2 Perceptions to Service and Career Options (continued)

Attributes	All Services				College Bound		Reserved Officers Training Corps		Total
	Navy	All Services	Work Bound						
A wide variety of opportunities to find a job you can enjoy	X	X					X		8
A physically challenging environment	X	X	X						6
An experience you can be proud of	X	X	X		X		X		10
An advantage over going right from high school to college	X	X	X						6
An opportunity to develop leadership skills	X	X	X		X		X		10
The chance to work with the latest high-tech equipment	X	X	X						6
A great value in your civilian career development	X	X					X		8
An excellent opportunity to develop self confidence	X	X	X		X		X		10
The opportunity to develop your potential	X	X	X		X				9

Table 10

## Allocation of Q87-2 Perceptions to Service and Career Options (continued)

Attributes	Army				Air Force	Marines
	Army	Reserves	National Guard			
A mentally challenging experience	X	X	X		X	X
An opportunity to become more mature and responsible	X	X	X		X	X
Many opportunities for training in useful skill areas	X	X	X		X	X
Many chances to work with highly trained people	X	X	X		X	X
An excellent opportunity to obtain money for college or vocational school	X	X	X		X	X
An opportunity to serve America while living in your own hometown		X	X			
An excellent opportunity for part-time work		X	X			
Interesting and exciting weekends		X	X			X
Four additional ROTC attributes						
Total Attributes	14	14	14		14	14

Table 10

## Allocation of Q87-2 Perceptions to Service and Career Options (continued)

Attributes	Navy	All Services	Work Bound	College Bound	Reserved Officers Training Corps		Total
A mentally challenging experience	X	X	X				9
An opportunity to become more mature and responsible	X	X	X				9
Many opportunities for training in useful skill areas	X	X	X				8
Many chances to work with highly trained people	X	X	X	X			9
An excellent opportunity to obtain money for college or vocational school	X	X	X				8
An opportunity to serve America while living in your own hometown.							2
An excellent opportunity for part-time work							2
Interesting and exciting weekends							2
Four additional ROTC attributes					X		1
Total Attributes	14	14	12	8		8	

- (5) College-bound high school students (Group 3) were asked three modules, active Army, ROTC, and one other.
- (6) Noncollege-bound high school students and high school graduates not currently enrolled (Groups 4 and 5, respectively) were asked active Army and one other set.
- (7) Secondary Male Sample/Secondary Female Sample (SMS/SFS) respondents were allocated as Group 4 and 5.

Two factors combined to determine the number of youth who actually received particular perceptions lists. First, the randomization programming determined the percentage of each panel receiving each list. Second, the sample composition had to match the estimates of actual sample composition made prior to the beginning of data collection.

Table 11 summarizes the performance of the random assignment. For each subsample, the first two rows represent the percentage of that panel that was planned to receive that service's perceptions list, and the actual percentage of the panel that received the list. For example, 67% of all freshmen and sophomores were expected to receive the active Army perceptions list, while 68% actually received the list. The small differences obtained between planned and actual assignment for all panel-service list combinations indicates that the random assignment programming performed well.

Table 12 presents the expected and actual PMS subsample compositions. Estimates of expected PMS subsample compositions were based upon the Current Population Survey and the Fall 1985 Youth Attitude Tracking Survey II (YATS II). We assumed that about 10% of all PMS respondents would have completed the third year of college or more, 24% would be freshmen and sophomores, 11% of high school students would be college-bound, 13% of high school students would be noncollege-bound, and that 42% of high school graduates would not be enrolled in college. We expected, for example, about 970 sets of responses to the ROTC questions annually from those in their third year of college or more, and so on.

However, as Table 11 demonstrates, the actual PMS subsample composition was quite different than expected. Major differences in expected versus actual distributions were:

- (1) Fewer college freshmen and sophomores were obtained than expected;
- (2) More college-oriented high school students were obtained than expected; and conversely, fewer work-oriented high school students were obtained than expected; and
- (3) Fewer high school graduates not currently enrolled were obtained than expected.



Table 11

Performance of Randomized Assignment of Subsamples to Perceptions Attributes Planned Versus Actual

		High Sch. Attended 3+ Years of College	High Sch. Freshmen and Sophomores	High Sch. Students College Screened	Students Work Screened	Students Not Enrolled
Army Attributes:	Planned Percent:	0	67	100	100	100
	Actual Percent:	0	68	100	100	100
ROTC Attributes:	Planned Percent:	100	67	100	11	11
	Actual Percent:	98	65	98	10	11
ARNG Attributes:	Planned Percent:	12	8	77	11	11
	Actual Percent:	12	9	26	10	11
USAR Attributes:	Planned Percent:	12	8	27	11	11
	Actual Percent:	11	9	26	10	12
Navy Attributes:	Planned Percent:	12	8	8	11	11
	Actual Percent:	13	8	8	12	11
Marine Attributes:	Planned Percent:	12	8	8	11	11
	Actual Percent:	12	8	8	14	11
Air Force Attributes:	Planned Percent:	12	8	8	11	11
	Actual Percent:	12	8	9	11	10
College Attributes:	Planned Percent:	12	8	8	11	11
	Actual Percent:	13	9	8	11	12
Work Attributes:	Planned Percent:	12	8	8	11	11
	Actual Percent:	14	8	7	10	11
Service Attributes:	Planned Percent:	12	8	8	11	11
	Actual Percent:	12	8	8	12	12

Table 12

## Estimated Versus Actual Subsample Composition

	Estimated Subsample Composition		Actual* Subsample Composition	
	N	% of Sample	N	% of Sample
Attained 3+ Years of College	970	10%	962	10%
Freshmen & Sophomores	2,338	25%	1,570	17%
H.S. Students College-Oriented	1,035	11%	2,987	32%
H.S. Students Work-Oriented	1,265	14%	776	8%
H.S. Grads Not Enrolled	3,700	40%	3,091	33%
Total	9,300	100%	9,386	100%

\*Actual panel composition of reports; data collected October, 1986 through December, 1987.

Approximately 10% of total PMS were college juniors and seniors, which corresponded closely with expectations. However, the number of college freshmen and sophomores interviewed fell short of expectations. While our plans expected about a quarter of the PMS sample to be college freshmen and sophomores, these groups actually comprised only 17% of total PMS interviewed. The difference was due largely to the difficulty in locating and interviewing these youth. College freshmen and sophomores were located through their nonschool households (i.e., parental households or independent households). Many youth located at their parental households were contacted at their phone number at the school housing. The response rate for youth in dormitories was 17% lower than the response rate for youth living in the parental home or in independent households.

The proportion of college-oriented high school students was almost three times as high as expected. (The distinction between college- and work-oriented students was determined by the response to the question "How likely is it that you will be going to college in the next few years?") This was due to two factors. First, high school students were easier to locate and interview compared to college students and non-enrolled high school graduates since the majority lived in households with their parents. Secondly, most high school youth identified themselves as college-oriented, thus increasing the proportion of college-oriented high school students and decreasing the proportion of work-oriented high school students. The proportion of work-oriented students was much lower than expected (8% vs 14%), which indicates that many youth who would not actually go to college identify themselves as college-oriented during high school.

The proportion of high school graduates not enrolled in a two- or four-year college in PMS was also lower than expected (33% vs. 40%). While we do not have specific data on the subject, we suspect that this shortfall may have been due to telephone undercoverage among these youth, and the difficulty of scheduling and interviewing this mobile and busy population.

Presentation of Perceptions attributes. The Perceptions module contained lists of attributes for work, college, military service in general, the Army and its components, and the other services. Respondents were asked whether they agreed or disagreed with attribute statements on a five point scale, from disagree strongly to agree strongly. Respondents could receive up to three lists of attributes, each list containing 8 to 14 attributes. The maximum number of attributes for a given respondent was 36 attributes.

During the first quarter, the lists were administered sequentially. For example, youth were asked to respond to 14 Army attributes, then 14 Air Force Attributes, then 8 ROTC attributes. Each attribute list was presented using a randomly selected attribute as the starting point.

During the pretest and first quarter of data collection, interviewers reported that respondents became bored with the presentation of long attribute lists within each referent service. Data indicated

that most responses tended toward the high end of the scale with little variance. It was feared that the length and monotony of the lists resulted in a loss of interest and fixation on a single response in order to move through the interview as fast as possible. This potential "response set" threatened a number of analyses central to the mission of ACOMS since the attributes represented the communications objectives of the Army and its components.

To reduce potential response set bias, the Perceptions module was reprogrammed to present the attribute lists by attribute across service rather than presenting the attribute lists by service. For example, during the first quarter of data collection, respondents were asked, "Do you agree or disagree that the Army offers a mentally challenging experience? Do you agree or disagree that the Army offers an experience you can be proud of? Do you agree or disagree that the Army offers..." When the list of attributes was completed with the Army as the referent, the list of attributes was asked again for a second service. Table 13 presents the order of presentation, by service, for 14 attributes used during Fall 1986 data collection.

Table 13

Order of Perceptions Module Attribute List Presentation, Fall 1986

	Service List	
	Service 1	Service 2
Attribute 1	1	15
Attribute 2	2	16
Attribute 3	3	17
.	.	.
.	.	.
.	.	.
Attribute 14	14	28

Beginning with the second quarter of data collection, respondents were asked "Do you agree or disagree that the Army offers a mentally challenging experience? How about the (SECOND SERVICE)? Do you agree or disagree that the Army offers an experience you can be proud of? How about the (SECOND SERVICE)? Do you agree or disagree that the Army offers..." Table 14 represents the order of presentation by attribute used during Winter 1987 and the remainder of ACOMS data collection.

Table 14

Order of Perceptions Module Attribute List Presentation, Winter 1987 through Fall 1987

	Service List	
	Service 1	Service 2
Attribute 1	1	2
Attribute 2	3	4
Attribute 3	5	6
.	.	.
.	.	.
.	.	.
Attribute 14	27	28

Despite the changes in presentation of attributes, no differences were found between the distributions and summary measures of central tendency found in the first and second quarters of perceptions data. A difference between these quarters would have supported the response bias hypotheses for the procedure used in the first quarter (i.e., listing attributes within service). Further, factor analyses yielded a single factor solution for both quarters of Perceptions data. These findings indicated that the observed patterns of response were due to a positive, undifferentiated Army image rather than response bias. See Wilson (1987) for a full discussion of these analyses and findings.

Recommendations for future instruments. The attribute lists contained within the Perceptions section represented the copy points used within Army and component advertising. The use of these attributes supported the Army's intention to evaluate the levels of recall of and agreement with the Army's communication objectives.

The decision to focus on these communication objectives, however, resulted in less satisfactory data for other analytic purposes, e.g., to assess the "true" Army image, or brand differentiation among the services and career options. To meet these analytic objectives more fully, a broader set of attributes would be necessary. Expanded sets of attributes should include negatively worded attributes and attributes representing images not emphasized in advertising. These alternative attribute list constructions were discussed extensively during ACOMS study design, but were rejected in favor of attribute constructions focused on the Army's communications objectives.

### The Parental Interview

Interviews were conducted with parents of 16- to 20-year-old PMS or PFS youth, referred to as the "parental linked sample." In households which contained no eligible youth, no parental interview was conducted. Only one parental interview was conducted within a single household.

### Identification of Parental Influencers, and the Identification of Head of Household

As described in Chapter 2, a random half of the households with 16-20 year old PMS or PFS youth were pre-designated for a male parental interview, and the other half was pre-designated for a female parental interview.

During the first quarter of data collection, the head of household was automatically interviewed as the parental influencer if he/she was of the same gender as that pre-designated for the parent. However, the pretest showed that this logic was flawed, since a youth could have several potential parental figures of the selected gender. For example, if a youth lives in a household with a mother and a stepfather, both his/her natural father and stepfather could be considered as the influential parent.

To resolve this issue, the identification of the head of household was decoupled from the identification of the parental influencer. Response categories for questions regarding adult members of the family were reworded to clarify parental relationship to the youth. For example, response categories were added to questions regarding adult females in the household to allow for mothers or stepmothers. If the youth lived with a stepparent of the selected gender, the youth was asked to select either the mother or the stepmother as the person who was most influential when making important decisions.

### Structure of the Parental Interview

The parental interview contained eight modules parallel to the youth instrument modules. They were asked in the following order:

- (1) Parental Influence: probed whether the parent had discussed military service with the target youth, his/her expectations for the target youth, and beliefs that military service was a good or bad idea for most young men and women.
- (2) Importance of Attributes: repeated the items in the youth version which assess the importance of attributes, this time asking the parent about the importance of these attributes to the target youth.

- (3) Media Habits: these items were identical to those asked of the youth and focused on the amounts of television, radio, and print material to which the parent was regularly exposed and his/her favorite programs and print vehicles.
- (4) Knowledge-Recall: these questions were also identical to those in the youth questionnaire and asked for unaided and aided recall of Army and other service advertising with questions.
- (5) Attitudes Toward Army Advertising: addressed how much the parent liked and believed the advertisements he/she had heard or seen, using the same items as those in the youth interview.
- (6) Perceptions/Beliefs: probed with the identical questions asked of the target youth about the extent to which the Army (by component), other services, military service in general, college, and civilian employment offered the attributes defined by the Army's communications objectives.
- (7) Knowledge-Awareness: assessed the parent's knowledge, as in the youth interview, of Army benefits and programs.
- (8) Demographics: elicited information on the parent's ethnicity, marital status, socioeconomic background and military experience.

In essence, the parental interview added one module to the youth questionnaire (Parental Influence), and dropped Education and Employment, Intentions/Propensity, Behaviors, Social Influences, Slogan Recognition, and the Parental Location and Tracking modules from the youth interview. Except in the Importance and Perceptions modules in which the referent for the items was changed to the youth (e.g., "Helping (his/her) career development"), nearly all question-wordings were identical to those in the youth questionnaire. Further, where random assignment to or within modules was performed for the youth interview, the parental interview was assigned to the same modules and sections. Thus, if the youth was asked questions on perceptions of Army and college attributes, the parent was also asked the Perceptions questions for Army and college attributes. Further, if the youth was asked Media Habits and Knowledge-Awareness, the parent was asked the same modules.

#### Quarterly Instrument Changes

During ACOMS data collection, the survey instruments were updated quarterly. Instrument modifications were conducted to enhance the flow of the interview and the ease of survey administration, or to reflect changes in Army advertising. For example, following the first quarter of data collection, the question "Is this person male or female?" was modified to "Is this 13- to 24-year-old male or female?" to eliminate confusion regarding the referent of the question. For the second quarter instrument, the USAR attribute,

"Having Weekend Excitement," was reworded to read, "Having Interesting and Exciting Weekends," in order to better capture the intent of the advertising message.

Questionnaire changes consisted of question additions, deletions, wording changes, response category changes, subpopulations modifications, and changes in the order of administration. Documentation for the ACOMS questionnaires and all changes can be found in the ACOMS Users' Manual (Westat, Inc., 1988).



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#### 4. SURVEY DATA COLLECTION OPERATIONS

Susan M. Englehart

##### The CATI System

The Army Communications Objectives Measurement Survey (ACOMS) interviews were conducted using Westat's proprietary computer-assisted telephone interview (CATI) system. The system consists of state-of-the-art software that facilitates the collection and processing of complex data. The CATI system was particularly appropriate for the ACOMS survey where the types of information collected from respondents varied according to key respondent characteristics.

The CATI system automated the presentation and elimination of sets of questions based on answers obtained earlier in the interview. Question wording choices and randomized question presentation were also automated. This capability made the interviewing process considerably more efficient than a hard-copy instrument and resulted in significantly less interviewer error.

The CATI automated scheduler program scheduled cases based on algorithms determined by the project staff and results of previous call attempts. The result of each call to a telephone number (e.g., no answer, appointment made, or complete) was entered into the system and determined whether subsequent attempts were necessary. A record of all attempts to each number was maintained and could be accessed to review that number's call history.

CATI's internal editing capabilities also reduced the amount of error and time required to process the survey data. CATI capabilities included internal validity checks for value ranges and on-line consistency checks between related survey items. These capabilities virtually eliminated the need for data retrieval and extensive post-interview data cleaning and editing. Turnaround time between data collection and analysis was therefore significantly reduced, thus permitting quarterly reports to be produced in a timely manner.

##### Interviewer Training

###### Training Agenda and Format

The first interviewer training session was held at Westat's Frederick Telephone Research Center (TRC) facility during the period October 13-19, 1986. Seventy-eight interviewers attended this series of training sessions. Additional training sessions were conducted in 1987 during the periods February 1-8, May 26-31, and September 26-October 2 with new groups of interviewers. All training sessions were conducted by ACOMS project members and the Telephone Research Center staff. The trainers utilized a series of scripts designed to demonstrate the purpose of each question, skip patterns, consistency checks, recording

conventions, and potential problems in the ACOMS interview. Training consisted of the following eight components:

- (1) General Interviewing Techniques (4 hours). This session introduced interviewers to Westat and survey research, showed them examples of types of questions and recording conventions, taught basic ways to obtain accurate data through listening and probing, and stressed methods for gaining respondent cooperation. Each interviewer received a manual that documented the material presented in the session.
- (2) CATI Training (4 hours). This session required trainees to work with an interactive computer program which instructed them on the proper use of the keyboard and the control keys for computer-assisted telephone interviewing.
- (3) Study Overview/Screening Training/Contact Procedures (4 hours). A brief introduction to the study, including background information regarding the purpose and client was presented. The remainder of the session consisted of a detailed discussion of the screening questions and the procedures for assigning the appropriate result codes for all household or non-household contacts.
- (4) Practice on Screener Questionnaire (2-6 hours). Prior to continuing the next phase of training, each interviewer was required to spend 2-6 hours administering the screener questionnaire to respondents drawn from a "dummy sample" in the local area. The number of hours each interviewer was required to practice the screener was predetermined by the supervisory staff based on the interviewer's level of experience.
- (5) Refusal Avoidance (1.5 hours) and Interactive Youth Lecture (2.5 hours). The initial part of this session consisted of a review and group discussion of the experiences and problems encountered by the interviewers during their practice interviews. A list of questions frequently asked by respondents and recommended answers was compiled by the project staff for the interviewers' reference. Techniques for avoiding respondent refusals were discussed.

The remainder of the session was devoted to the youth interview including a detailed discussion of the intent of each question in the instrument, and instructions regarding the correct procedures for entering the data.

- (6) Respondent Selection/Interactive Parent Lecture (4 hours). Since a critical element of the ACOMS study was the identification and interviewing of the PMS/PFS sample, the CATI system was programmed to provide the interviewer with the ability to select respondents according to this priority. The specifications for target youth and the procedures for respondent selection were discussed.

The second part of the session consisted of a detailed demonstration of the parent questionnaire.

- (7) Scripted Practice (4 hours). Scripted interviews based on the youth and parent questionnaires were presented during which the trainer acted as the respondent and interviewers took turns asking the questions. These scripts were designed to demonstrate specific skip patterns and to reinforce CATI conventions and project definitions introduced in previous sessions. Special emphasis was placed on unusual situations, responses, and practice in answering respondent questions.
- (8) Role Plays (4 hours). Interviewers were divided into pairs with one person first assuming the role of interviewer and then that of the respondent. The "respondent" was provided with a script designed to simulate an actual interview in order to permit both interviewers to practice the skills learned. Trainees were instructed to follow the scripts without deviation to ensure a standard training experience and to reinforce probing and problem handling techniques introduced during the formal instruction sessions.

The training facility was equipped with a sufficient number of terminals to allow each interviewer to enter responses via the keyboard during approximately half of the training. A supervisor positioned at a lead terminal entered the correct responses during training. This terminal was connected to an overhead projector so that the trainer and interviewers could refer to an enlarged version of the correct screen during the training. All TRC supervisory staff assigned to the project attended the training sessions and provided support to the trainers.

In addition to the formal training, interviewers were requested to spend 4 hours at home reviewing the project manual, completing prepared exercises, and practicing responses to frequently-asked questions. The total number of training hours for a new interviewer was 34; the total for an experienced interviewer was 22.

### Training Materials

Written materials were provided for the interviewers to use during the training itself and as reference tools during the interview process. The written materials included the interviewer training manual, a reference list of the questionnaire modules, a magazine list, and a list of likely respondent questions coupled with preferred answers.

The Interviewer Training Manual. The ACOMS Training Manual consisted of two main parts: a general description of the study, and the question-by-question specifications for the survey.

Figure 2 is a copy of the Table of Contents for the Training Manual. These chapters introduced the study's main objectives, described sample selection procedures, discussed problems that might be

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Figure 2. Example of the interviewer Table of Contents.

encountered by interviewers, and provided a brief overview of the survey instrument.

The introductory material was followed by an appendix containing illustrations of all of the screens in the CATI program. Accompanying the screen illustrations were explanations of when the screens would appear (i.e., skip patterns), definitions for project purposes (e.g., "household," "principal wage earner," "education levels," etc.), and clarifications for questions that could be misunderstood or answered ambiguously. One example of the latter was the question "What is the highest grade or level of schooling that you have completed and received credit for?" Respondents often answered this question by giving their current educational status (e.g., "I am a college sophomore."). Text accompanying this question and shown on the screen instructed interviewers to attend to the underlined words in the question and to probe the respondent's answer by verifying that he/she has completed and received credit for his/her first year of college. Additionally, interviewers were instructed to probe whether the respondent attended a 2- or 4-year college. Specification of question intent was provided to ensure that interviewers probed and coded respondents' answers as intended by the questionnaire designers.

Additional training materials. In addition to the training manual, three other types of reference materials were provided to the interviewers:

- (1) Module List (Figure 3). The 16 unique modules contained in the three questionnaires (screener, youth and parental interviews) were listed by name and reference letters (e.g., Social Influence [SI]). A brief description of the module's contents was also provided. The list was intended to serve as an easy reference tool by interviewers to help them become familiar with the various sections of the survey instrument and their purposes. The list was included in the Training Manual and was also provided on a separate page for easy reference.
- (2) Respondents' Question List (Figure 4). A two-page list of anticipated respondent questions was also provided along with suggested answers for each. It was included in the Training Manual as well as on separate cards for easy reference while interviewing.
- (3) Magazine List (Figure 5). A magazine list was provided for use in the Media Habits module, where respondents were asked to name the magazines they read on a regular basis. The magazine list provided an extensive alphabetical enumeration of popular magazines paired with three-digit code numbers for interviewers' use in recording respondents' answers.

**Household Screener (SC):** This section has questions designed to locate households with members eligible for inclusion in one of the samples. Based on responses to these questions, the computer will decide if an appropriate respondent has been found or if the interview should be terminated.

**Education and Employment (EE):** Youth will be asked questions regarding their educational and work experiences.

**Career Military Intentions or Propensity (IP):** This section measures the youth's perceived likelihood that he or she will enlist in the Army or will choose some other career option in military or civilian life.

**Behaviors (BE):** This section includes questions on the youth's exploration of, or interest in, various career options, including the Army.

**Social Influence (SI):** The influence of family, friends and educators has been considered important in the decision to enlist. This section contains questions about what the youth perceives to be the attitudes of key persons towards his or her joining the Army.

**Importance of Key Attributes (IA):** This section contains questions on the importance of various factors, such as giving service to your country and developing one's potential, that may influence career choices.

**Media Habits (MH):** Questions here fall into two classes: (1) items focused on the respondent's TV viewing, radio listening, and magazine and newspaper reading habits, and (2) items focused on specific shows and magazines that might have been seen, heard, or read.

**Knowledge Recall (KR):** A basic way to measure how knowledgeable respondents are about military communications is to ask whether they recall Army and other services' advertisements in general, and particular messages in those advertisements specifically.

**Attitudes towards Army Advertising (AT):** This section measures how much respondents like Army ads and how much they believe what the ads say.

**Knowledge/Slogan Recognition (KS):** Respondents will be asked to match slogans in military advertisements with the services that use them.

**Perceptions/Beliefs of Army Attributes (PE):** Items in this section ask whether serving in the Army offers certain opportunities, such as developing leadership skills. The second set of items focus on perceptions about people who join the Army.

**Knowledge/Awareness (KA):** These items focus on specific Army incentives, such as pay, education benefits, and training.

**Parental Influence (PI):** This section asks parents about actions they have taken to influence their child's career decision-making process.

**Demographics (DE):** Items here ask about parents about actions they have taken to influence their child's career decision-making process.

**Parental Location (PL):** A randomly selected portion of youth will be asked for the name and telephone number of one of their parents, who will then be interviewed.

**Tracking Information (TR):** The youth chosen to be part of a longitudinal subsample will be asked for information which will make it easier to recontact them for the follow-up interview.

Figure 3. Questionnaire modules.

"I have no time."

We can do it at any time that is convenient for you. (Pause) If you don't have time now, just tell me when and I can call you back. Your participation is that important to the success of the survey.

"How long will this interview take?"

*If the question refers to the screener:*

The first part of this survey is very short. It will take about 5 minutes and that may be all the time we need. If we need more time for additional questions, I will let you know at that point.

*If the question refers to the Youth interview:*

Depending on your answers, it will take between 20 and 30 minutes.

*If the question refers to the Parent interview:*

Depending on your answers, it will take about 15 or 20 minutes.

"How did you get my telephone number?"

Your number was randomly dialed from a list of all telephone prefixes used in the United States.

"Why can't you interview someone else?"

We can't substitute someone else. If we did that, the sample would not be scientifically accurate and we couldn't rely on the results we got.

"Why do you want to talk with me?"

We are surveying only young adults in a particular age range, and sometimes their parents. If there are other persons in your household in this age range, you were the one who was randomly chosen to be included in the survey.

"How do I know you are who you say you are?"

If you wish, you can call my supervisor. She/he can be reached at 800-423-6754 and can give you all the particulars of the study.

"Do I have to answer your questions?"

No, your participation in the study is entirely voluntary, and you will not be urged to answer any question that makes you uncomfortable. Since your name will never be released in connection with the survey, though, we hope that you will choose to participate.

"How do I know you will keep this information confidential?"

We are required by law not to reveal any information except to the Westat research staff working on the study. Each of us is required to sign a statement to keep as confidential all information provided by respondents. Survey results will be published only as statistical totals. No information which would permit the identification of an individual will be released or published.

"What is the background noise I am hearing?"

Your answers are being entered directly into our computer system.

Figure 4. Respondent's question list.



**"What is the purpose of the survey?"**

The survey focuses on the career planning of young adults and how information about military service figures in their thinking. There are also some questions on the messages people receive from advertisements sponsored by the military.

**"Who is sponsoring/funding this study?"**

This study is being conducted for the U.S. Army Research Institute in Washington, D.C.

**"What types of questions will you ask me?"**

The interview will generally be about what you have seen, heard, or read about serving in the Army today. We will also ask about your plans for the future.

**"Will the Army know you talked with me and what I said?"**

We won't be asking the name of most of the people we will survey. Information that might identify specific persons, such as names, addresses and telephone numbers will never be given to the Army.

**"Do you work for the Army?" or "Are you a Recruiter?"**

No, I am employed by Westat Incorporated, a survey research firm located in the Washington, D.C. metropolitan area. We are conducting this survey under contract with the U.S. Army Research Institute.

**"I had a bad experience with the government/military." or "I've never liked the military. Why should I help them by answering your questions?"**

This is a special research effort, and we are interested in your opinions whether they are positive or negative.

**"Can you/will you give my name to a recruiter?"**

No, we are only conducting a survey and have no contact with Army/military recruiters.

**"How will the survey results be used?"**

The Army needs to know whether young adults and their parents are picking up the messages Army advertising is trying to send. If the messages are not being received, the advertising has to change.

The messages concern what it's like to be in the Army. The Army is an all-volunteer force that relies upon young adults viewing it favorably and enlisting for duty. If the Army can effectively communicate what it offers, young adults can make more informed career decisions regarding military service.

**"Why do you want my Social Security Number?"**

Providing us with your Social Security number is voluntary. We want to see whether any of the ideas we've been discussing are related to whether or not someone eventually enlists in the Army. No one in the Army or anyone else in the government will ever see your Social Security Number or anything else that could be used to identify you.

Only research project staff would have access to your Social Security Number. Each member of the research staff is required to sign a statement never to reveal confidential information.

**"Will you use my Social Security number to look at other government records on me?"**

Only the records of the Army will be consulted by Westat staff. We simply want to see whether people with certain attitudes toward the Army eventually enlist in it. We are required by law not to reveal any information except to the Westat research staff working on the study. Each of us is required to sign a statement to keep as confidential all information provided by respondents.

Figure 4. Respondent's question list. (continued)

101 A&A JOURNAL	144 DENTAL STUDENT	199 NURSING WORLD WEEKLY
102 A&A JOURNAL	145 DIRECTIONS	200 NURSING WORLD JOURNAL
103 ADVANCE	146 DOLLAR & SENSE	201 NURSING & HEALTH CARE
104 ATP	147 DOWN	202 NURSING 84
105 AMATEUR SPORTS	148 DOWNBEAT	203 DOWN
106 AMERICAN EDUCATOR	149 DRUG THERAPY	204 ON "ARMS"
107 AMERICAN FAMILY PHYSICIAN	150 ECHO	205 ON YOUR OWN
108 AMERICAN JOURNAL OF NURSING	151 ECHO '84	206 OUTDOOR LIFE
109 AMERICAN JOURNAL OF NURSING-- GUIDE 87	152 FAMILY COMPUTING PROGRAM	207 PARADE
110 AMERICAN JOURNAL OF NURSING*	153 FAMILY PRACTICE NEWS	208 PASTORAL LIFE
111 AMERICAN MEDICAL ASSOCIATION JOURNAL	154 FIELD AND STREAM	209 PEOPLE
112 AMERICAN OPERATING ROOM NURSE JOURNAL	155 FIRST OPPORTUNITY	210 PETERSON'S GUIDE
113 AMERICAN OPTOMETRIC ASSOCIATION JOURNAL	156 FOCUS	211 POPULAR MECHANICS
114 AMERICAN VISION	157 GAMES	212 POPULAR SCIENCE
115 ARMY NAVY FOOTBALL PROGRAM	158 GUIDE FOR NURSES	213 NEARBY DINING
116 ARMY POST NEWSPAPERS	159 OUTPOST	214 RESIDENT & STAFF PHYSICIAN
117 ATION PUBLICATIONS	160 HIGH FIDELITY	215 RIGHT CHOICES
118 A&A GUIDANCE NEWSLETTER	161 HIGH SCHOOL SPORTS	216 ROAD AND TRACK
119 BARNISTER	162 HISPANIC BUSINESS	217 ROLLING STONE
120 BLACK COLLEGE SPORTS REVIEW	163 HISPANIC USA	218 R.N. (REGISTERED) NURSE
121 BLACK COLLEGE	164 HORILETTIC & PASTORAL REVIEW	219 SCHOLASTIC COACH
122 BLACK ENTERPRISE	165 HOT RED	220 SCHOOL COUNSELOR
123 BLACK IPS	166 IMPRINT	221 SCHOOL SHOP
124 BLACKBOX	167 INDUSTRIAL EDUCATION	222 SCIENCE DIGEST
125 BONE AND JOINT SURGERY JOURNAL	168 INSIDE SPORTS	223 SELECTIONS
126 BOY'S LIFE	169 INSTRUMENTALIST	224 SENIOR SCHOLASTIC
127 CANNIBS	170 INTERNATIONAL MUSICIAN	225 SPOT
128 CAMPUS VOICE	171 JAZZ TIMES	226 SPORTING NEWS
129 CANNIES	172 JET	227 SPORTING NEWS YEAR BOOK
130 CAR AND DRIVER	173 JOURNEY	228 SPORTS
131 CAR CRAFT	174 KEY PUBLICATIONS	229 SPORTS AFIELD
132 CAREER MAGAZINE	175 LIFE	230 SPORTS FITNESS
133 CAREER UNLIMITED	176 KID	231 SPORTS ILLUSTRATED
134 CAREERS	177 MEDICAL TRIBUNE	232 IN SCHOLASTIC
135 CASE & COMMENT	178 MEN'S LITURGY	233 STEREO REVIEW
136 CHANGING TIMES	179 MONEY	234 STUDENT LAMP
137 CIVIL AIR	180 MOTOR TRENDS	235 SUNDAY AND RETIRED
138 CLASS OF --	181 MUSIC EDUCATOR'S JOURNAL	236 TALBOT'S GUIDE
139 COLLEGE NEWSPAPERS	182 MUSICIAN	237 TEENAGER
140 COLLEGE PREVIEW	183 NATIONAL A&A ASSOCIATION BULLETIN	238 TENS
141 CYCLE	184 NATIONAL BLACK MONITOR	239 THE CLARINET
142 DASH	185 NATIONAL CATHOLIC REPORTER	240 THE PRIEST
143 DELEGATE	186 NATIONAL DENTAL ASSOCIATION JOURNAL	241 TIME
	187 NATIONAL FUTURE FARMER	242 TODAY'S EDUCATION 1985-86
	188 NATIONAL GEOGRAPHIC	243 TODAY'S PAPER
	189 NATIONAL SCENE	244 TRUCKS
	190 NEWS WEEKENDY NEWSLETTER	245 TV GUIDE
	191 NEW TODAY	246 USA TODAY
	192 NEUROLOGY	247 U.S. NEWS AND WORLD REPORT
	193 NEW ENGLAND JOURNAL OF MEDICINE	248 VARIETY
	194 NEWSWEEK	249 VEGA
	195 NEWSWEEK ON CAMPUS	250 VIDEO AND SOUND
	196 NESTING	251 VISION
	197 NURSING OPPORTUNITIES '87	252 VISTA
	198 NURSING OUTLOOK	253 VOCATIONAL ED & SCHOOL SHOP TEACHER
		254 VOCATIONAL GUIDANCE QUARTERLY
		OTHER
		991 OTHER

Figure 5. Magazine list.

## Data Collection Operations

### Interviewing Periods

Each monthly sample of telephone numbers was active for an eight week period, beginning on the first day of the month. During this period, attempts were made to contact all telephone numbers in the sample, to separate households from non-households, to conduct the household screening interviews, and to complete the youth interviews.

Attempts were made to initiate the parental interviews as soon as each parental-linked youth interview was completed. The period for interviewing the parental sample extended two weeks beyond the close of the eight week period designated for the youth interviews.

This schedule implied that, at any one point in time, several sample cohorts were available for interviews. A complex data collection management system was therefore necessary to monitor data collection progress for each monthly cohort.

### Staffing

The Frederick Telephone Research Center (TRC) operated from 9 a.m. to 12 p.m. on Mondays through Fridays, 10 a.m. to 6 p.m. on Saturdays, and 2 p.m. to 10 p.m. on Sundays. Interviewers were scheduled on the ACOMS project during all time periods to permit adequate coverage of households located in the four time zones of the United States. Interviewer shifts ranged from four to eight hours.

Weekly project meetings held at the TRC facility included the facility manager, ACOMS project director and other project staff, TRC project supervisor, key ACOMS CATI programmers, and the data preparation supervisor. Topics discussed during these weekly meetings included effective interviewer scheduling, training needs, work flow, CATI hardware and software, data cleaning and coding, and project procedures.

The TRC operations manager functioned as the primary liaison between the TRC and ACOMS project staff. The manager worked closely with the project supervisor and shift supervisors. The operations manager and project supervisor reviewed all problem cases and were responsible for establishing procedures for the resolution of these cases.

### Quality Control

Project supervisors were located "on the floor" with the interviewers during all hours of TRC operation. Using extension telephones and displays linked to the interviewers' CRTs, supervisors monitored approximately 10% of each interviewer's work during the study. Each time an interview was monitored, the supervisor would complete a monitoring form. At the completion of the interview, the supervisor provided feedback to the interviewer regarding his/her techniques of gaining cooperation and asking questions, and the accuracy of responses.

recorded. Problems commonly encountered by interviewers were discussed in memos and regular interviewer meetings.

Supervisors were responsible for monitoring interviews and ensuring that problems were quickly identified and resolved. Whenever it was not possible to resolve a problem immediately, a CATI Problem Sheet was completed by the interviewer and brought to the attention of the TRC project supervisor for review and resolution. This sheet provided space for the interviewer to record the pertinent identifying information regarding the case and a complete description of the problem encountered. A CATI Update/Comment Sheet was also completed by interviewers whenever they needed to have a data item corrected, e.g., a screener respondent provided an incorrect spelling of a youth's name which the youth subsequently corrected. The interviewers used this sheet to record the case identifying information and the corrected information. After reviewing the information contained on these forms and the information recorded on the CATI file, the project supervisor would route the sheets to the data preparation staff if changes in the data file were necessary.

A core of experienced interviewers was identified and trained to assist in resolution of problem procedure cases, e.g., during subsequent contacts with a household there was a discrepancy in the description of household's composition. All problem cases were reviewed thoroughly by the project supervisor and operations manager and subsequently routed to either the CATI programmers or data cleaning staff as appropriate.

Data quality was also ensured by regular reviews of data frequencies. These reviews ensured that correct branching occurred and the data were being stored properly. Irregularities were discussed and resulted in data changes or minor revision in CATI programming.

#### Production Reporting and Management Systems

In order to facilitate management of the complex data collection effort, numerous reports were developed. These reports contained summaries of pertinent information at both the interviewer and project level.

#### Interviewer Reports

The Telephone Information Management System (TIMS) report provided weekly information regarding the total number of hours scheduled on the project by day of week and by day/evening/weekend hours. This information was available on a projected basis for the upcoming week and as actual hours worked for the previous week. A cumulative summary of this information was provided for the project staff. Additional reports listing projected and actual hours worked for individual interviewers were also generated on a weekly basis.

Another report displayed the number of people logged onto the ACOMS account every hour the project was operational during a given week. This report was useful in comparing the number of interviewers projected to be working at a given time with the actual number.

Weekly interviewer reports reflected the final disposition of each finalized case and response rates on an individual interviewer level. These interviewer-specific reports enabled the supervisory staff to identify interviewers with a low level of productivity or staff who required additional training.

#### Interviewing Status Reports

Various project-level reports were also generated to track the work flow and response rates for the different components of the study, i.e., screener, youth, and parent interviews. These reports reflected the status of all sample telephone numbers by final disposition, such as complete, final refusal, out-of-scope, and interim dispositions such as callbacks, first refusal, etc. The Project Report tracked response rates for each interview component before and after refusal conversion efforts. A unique feature of the Daily Report for ACOMS study was a calendar displaying the daily counts by sample month of completed out-of-scope numbers, i.e., non-residential (NR) and non-working (NW), and completed screener, youth and parental interviews.

## 5. ACOMS SURVEY SAMPLE WEIGHTING, FACTORS AFFECTING SAMPLE PRECISION, AND ANALYSIS METHODOLOGY

Michael J Wilson and Leyla Mohadjer

### Introduction

This chapter provides a discussion of: (a) the methodology used for the calculation of survey sample adjustment weights, (b) factors affecting the precision of sample estimates, and (c) the methods used for testing the statistical significance of parameter estimates utilized in the analysis of data from the Army Communications Objectives Measurement System (ACOMS) survey.

The ACOMS youth and parent samples were drawn utilizing clustering, stratification, and supplementation techniques in order to assure compliance with subpopulation sample size requirements. As a consequence, respondents were selected with differing probabilities of sample selection depending upon demographic and other characteristics. These departures from a simple random sample (SRS) design complicated the processing and analysis of ACOMS survey data.

Sample adjustment weights had to be calculated and used in order to produce unbiased estimates of ACOMS population parameters. For example, without the use of adjustment weights, the ACOMS youth sample would estimate the proportion of males and females in the population as .83 and .17, respectively. Sample adjustment weights are used to compensate for unequal selection probabilities among the ACOMS subpopulations. This chapter presents the methodology followed in weighting the ACOMS youth sample and calculating adjustment weights for the perceptions and noncore questionnaire modules as well as for the parental sample.

Survey sample design and design related factors such as sample weighting adjustments affected the precision of sample estimates. For example, departures from a SRS design such as the cluster sampling used in ACOMS increased the variance of population parameter estimates relative to that which would be expected from a SRS design. In general, while complex sample designs can markedly improve the effectiveness of data collection, they do so at the expense of efficiency in variance estimation. The term used to describe and quantify this relative (to a SRS design) efficiency is design effect. In addition, the use of sample adjustment weights can affect the precision of estimates. If sample adjustment weights are highly variable (i.e., unequal), the variance of estimates will be greater than would be expected if all weights were equal. The term used to describe this source of increase in variance is unequal weighting effect. This chapter discusses the calculation and magnitude of ACOMS design and unequal weighting effects for various sampled subpopulations.

The use of a complex sample design also had implications for the statistical analysis conducted on ACOMS data. In order to perform tests of statistical significance, two methodologies were utilized. For contingency

table analysis an approximate chi-square statistic was computed which took into account actual sample size and the magnitude of unequal weighting effects. All other significance tests were accomplished using the method of balanced repeated replications (BRR). This chapter ends with a brief description of the approximate chi-square statistic and BRR methodology.

#### Weighting the ACOMS Sample Data

The ACOMS sample design did not produce a self-weighted sample of individuals who are members of the eligible youth population. Sample adjustment weights, with different weights for various subdomains of the population that have been sampled, were necessary for the production of unbiased parameter estimates. (In addition, a second set of weights were produced for the Perceptions and non-core questionnaire modules). Sample adjustment weights were used with ACOMS data to provide estimates of statistics (means, proportions, correlations, etc.) that would have been obtained if the entire sampling frame had been surveyed. The ACOMS weighting methodology was implemented to accomplish the following objectives:

- (1) to bring sample data up to the dimensions of population totals;
- (2) to adjust for differential probabilities of selection among subgroups (Hispanics, females) of the population;
- (3) to minimize biases arising from the fact that nonrespondents may differ from survey respondents;
- (4) to compensate for inadequacies in the sampling frame (the sampling frame excluded nontelephone households and possibly persons living in unconventional settings); and
- (5) to reduce variances of estimates by using auxiliary information that is known with a high degree of accuracy in the estimation procedure.

Three distinct sets of weighting adjustments were calculated for the ACOMS data depending upon the sample and questionnaire modules under consideration. First, youth sample weights were calculated for the entire sample. Next, adjustments were calculated for perceptions and non-core questionnaire modules. Finally, adjustment weights were computed for the ACOMS parental sample.

#### Youth Sample Weights

Calculation of sample adjustment weights for the ACOMS youth sample was accomplished in three steps. The first two steps involved computation of weights compensating for unequal probabilities of selection at the household and person level. The third step used poststratification (also referred to as ratio-estimation) to adjust for sample nonresponse, compensate for the omission of nontelephone households, and reduce sampling errors.

Sampling rate adjustments at the household level. The modified Waksberg method was used to sample households. In this approach, a constant number of telephone numbers per cluster (rather than households, as in the standard method) were selected. As a result, households had differential probabilities of selection. The rate at which a household was sampled depended on the proportion of telephone numbers within a cluster proving to belong to households. As a result, a weight was attached to each cluster equal to the average number of sampled households per cluster divided by the number found in the particular cluster. That is,

$$W_i = \frac{\bar{n}}{n_i}$$

where  $\bar{n}$  is the average number of households per cluster, and  $n_i$  is the actual number of sample households in the  $i^{\text{th}}$  cluster.

Additionally, households with two telephone numbers had twice the chance of selection and were over represented in the sample. Thus, they were given a weight of 1/2 to adjust for this overrepresentation. Variable  $I_{ij}$  was defined in the following way:

$$I_{ij} = \begin{cases} 1 & \text{if household } j \text{ in the } i^{\text{th}} \text{ cluster had} \\ & \text{one telephone number, or} \\ 1/2 & \text{if household } j \text{ in } i^{\text{th}} \text{ cluster had more} \\ & \text{than one telephone number.} \end{cases}$$

The household level or first stage weight, then, was defined as

$$W_{lij} = W_i \cdot I_{ij} = \frac{\bar{n}}{n_i} \cdot \begin{cases} 1/2 \\ \text{or} \\ 1.0 \end{cases} \quad (1)$$

It was observed during the weighting of data from the first quarter of data collection that a small proportion (approximately 3 percent) of clusters had fewer than four screened households. As a result, respondents from these clusters were assigned very large household weights which correspondingly increased sampling variances (due to considerable variability in the magnitudes of household weights). To avoid this problem of disproportionately large household weights (and sampling variances) in the second and subsequent quarters, constraints were placed on the magnitude of acceptable household weights. Specifically, weights assigned to clusters with fewer than four screened households were set equal to the weight for clusters with four screened households.



This approach produced smaller sampling variances at the price of introducing some unknown bias due to under-representation of households obtained from clusters having one, two, or three screened households. (The bias depends on unknown factors such as nonresponse.) Since a very small proportion of clusters had fewer than four screened households, it is assumed that the bias is negligible in comparison to the gains obtained from reducing the sampling variances.

Sampling rate adjustments at the person level. The ACOMS survey design dictated the sampling of various population subgroups at different rates. For example, Hispanics were oversampled and females undersampled. It was necessary, therefore, that sample weights adjust for the differential sampling rates used for population subgroups in addition to adjustments for sample selection probability at the household level. Sample rate weighting adjustments calculated for each person reflected his or her actual probability of selection. This adjustment was made by multiplying each person's first stage (i.e., household) weight by the reciprocal of the probability of selection for the subdomain. The second stage or person-level weight was defined as

$$w_{2ijk} = w_{1ij} \cdot w_{ijk} \quad (2)$$

where  $w_{ijk}$  is the reciprocal of the probability of selection for the  $k^{\text{th}}$  individual in the  $j^{\text{th}}$  household in cluster  $i$ .

These adjustments ensure that the weighted counts or proportions for females and Hispanics, for example, reflected their composition in the youth population rather than the sample design. This was very important as unweighted counts or proportions would be very misleading when used as estimates of population values.

Poststratification. Poststratification was used to reduce sampling errors, to minimize biases arising from differences between respondent and nonrespondent groups, and adjust for the exclusion of nontelephone households from the sampling frame. Poststratification adjusted the weights calculated in the first two stages of weighting by creating agreement between weighted ACOMS tabulations and census estimates of the total population by age, sex, race and ethnicity.

Nonresponse and inadequacies in the ACOMS sampling frames were expected to vary by population groups and therefore potentially distort sample distributions. Poststratification compares the distribution of the population and the sample across selected variables and computes sample weights to ensure that sample proportions on key demographic characteristics closely approximates known population proportions. When post-stratification is not applied to sample data, obtained weighted sample distributions may differ substantially from those in the population.

There was a difference in the poststrata formed for the weighting of the first three quarters of data collected and those used in weighting year two data. This difference will be documented following a discussion of the post-stratification methodology as applied to the first three quarters of ACOMS data.

Four variables were used for construction of poststrata for the first three quarters of data:

- |     |                 |  |
|-----|-----------------|--|
| (1) | Brigade:        | 5 categories   |
| (2) | Sex:            | 2 categories   |
| (3) | Race/Ethnicity: | 3 categories<br>(Black non-Hispanic/<br>Hispanic/Other)  |
| (4) | Age:            | <div>males 4 categories<br/>(16-17/18-19/<br/>20-21/22-24<br/>years old) and</div> <div>females 2 categories<br/>(16-19/20-24<br/>years old)</div> |

Poststratification by these variables was necessary to assure that sampling proportions on these key variables were similar to population proportions and to allow Army analysts to make comparisons of ACOMS findings with other survey efforts such as the Youth Attitude Tracking Survey (YATS).

This strategy yielded the following poststrata cells for the first three quarters of ACOMS data.

		<u>COLUMNS</u>
		Brigade
Males	<u>ROWS</u>	
	by race/ethnicity by age	
Females	<u>ROWS</u>	
	by race/ethnicity by age	

There is a practical problem in calculating poststratification weights when the number of crosstabulation cells is very large. Some of the cells may contain no sampled individuals while others may contain only a small number. To avoid problems arising from small sample sizes within poststrata cells, raking (also termed iterative proportional fitting) was used to compute the adjustment weights for the poststrata. Raking is an iterative procedure that estimates weights so that weighted sample estimates equal population controls for the marginals of the various poststrata without ensuring this quality for each of the crosstabulation cells. That is, raking will ensure that weighted marginal distributions of recruiting brigades, sex, race/ethnicity, and age will agree with known population marginals but raking does not attempt to achieve a correspondence between sample and population values in the cells of the crosstabulation.

The poststratification weights  $W_{hlmn}$  were computed so that

$$\sum_{lmn} W_{hlmn} * W_{2ijk} = N_{h...}, \quad \begin{array}{l} h = 1,2,4,5,6 \\ \text{- brigade;} \end{array} \quad (3)$$

$$\sum_{hmn} W_{hlmn} * W_{2ijk} = N_{.l...}, \quad \begin{array}{l} l = 1,2 \\ \text{- sex;} \end{array} \quad (4)$$

$$\sum_{hln} W_{hlmn} * W_{2ijk} = N_{...m}, \quad \begin{array}{l} m = 1,2,3 \\ \text{- race/ethnicity; and} \end{array} \quad (5)$$

$$\sum_{hlm} W_{hlmn} * W_{2ijk} = N_{...n}, \quad \begin{array}{ll} n = 1,2,3,4 & \text{if } l=1 \\ n = 1,2 & \text{if } l=2 \\ \text{- age.} \end{array} \quad (6)$$

To simultaneously solve equations (3) to (6) for the poststratification weights, the raking procedure proceeds iteratively by proportionately weighting poststrata cell values so that each of the equations is satisfied in turn. Each new iteration begins from the results of the previous step and continues until all equations are satisfied to the degree of precision required.

The weight for each individual during the first three quarters of data collection was the product of the poststratification weight and  $W_{2ijk}$ , computed in equation (2).

$$W_{3hijklmn} = W_{hlmn} * W_{2ijk} \quad (7)$$

In the second year of data collection, education was added as a post-stratification variable. The poststrata cells for the second year of data collection were:

<u>COLUMNS</u>	
Brigade by Education of head of household	
<u>ROWS</u>	
Males	by race/ethnicity by age
Females	by race/ethnicity by age

The addition of another dimension to poststratification added one more subscript to the weight and another equation to satisfy during raking. The methodology remained unchanged, however. The weight for the second year of data was

$$W_{3hijklmno} = W_{hlmno} * W_{2ijk} \quad (8)$$

The March supplement of the 1986 Current Population Survey (CPS) was used for the poststrata population counts for the first three quarters of data collection and the March supplement of the 1987 CPS was used for the second year. Poststrata population counts were based on the CPS estimates for 16- to 24-year-old youths excluding in-service youth and college graduates. The CPS estimate of in-service youth did not, however, include those who had been accepted into a branch of the military and were waiting to go on active duty (a characteristic of the ACOMS sample definition) or a reliable estimate of the number of youth with prior military service. To estimate population proportions for these groups, information available from the ACOMS screener regarding youth waiting to enter the military and those with prior service was used. The poststrata population counts obtained from the CPS were then adjusted to exclude these groups. These two estimated proportions remained stable throughout the data collection period.

Final poststratification weighting adjustments were trimmed in a manner analogous to that used in the establishment of household level weights. The purpose served was the same as well (i.e., to reduce variance inflation due to highly variable adjustment weight values). Sample poststratification weights were first examined for unacceptably large values and the cells containing these weights identified. The largest weight was then constrained to be equal to the value of the next highest weight. The difference between these weights was then distributed proportionately among the remaining weights in the poststratum.

### Adjustment Weights for the Perceptions and Non-Core Modules

As described more fully in Chapter 3 (Allen, Nieva, & Gaertner, 1988), sections of the Perceptions module, the rotating modules (Media Habits, Slogan Recognition and Knowledge of Army Offers) and the Social Influences and Parental Location modules were administered to designated subsamples of respondents. The ACOMS Perceptions module included questions referring to perceptions of the active Army, ROTC, National Guard, and U.S. Army Reserve, perceptions of other military services (Air Force, Navy, and Marines), and perceptions of other, nonmilitary options (i.e., attending college and in civilian employment) open to respondents in targeted age groups. In order to restrict respondent burden to an average of 30 minutes per questionnaire administration, respondents were only asked their perceptions about two, or at most three, of the referents identified above. The distribution of perceptions questions by respondents varied across the military and civilian option referents depending on the allocation formula described in Chapter 3 (Allen, Nieva, & Gaertner, 1988) of this document. For example, almost all college students were asked their perceptions of ROTC, whereas only a small portion of college students were asked their perceptions of the Navy or Marines.

Similarly, random half-samples of respondents were administered the Media Habits, Slogan Recognition, Knowledge of Army Offers questionnaire modules. (These are termed "rotating modules.") Additional sets of weights were computed reflecting the sampling rates used for selecting respondents for these modules and perception sections. The weights were equal to the product of the reciprocal of selection probability for the rotating modules or perceptions sections and the sampling weight computed in equation (7) or (8) as appropriate.

The procedures for weighting the Social Influence and Parent Location modules were slightly different. These modules were only asked of those 16- to 20-year-old Primary Male Sample (PMS) and Primary Female Sample (PFS) youth who were selected for parental interviews. Only one age-eligible PMS/PFS youth per household was selected to be part of the parental linked sample. Therefore, the youth base weights, as computed in equation (2), were adjusted for multiple number of eligibles in households. Furthermore, the poststratification counts had to be adjusted to include only the 16- to 20-year-old PMS/PFS youth in the population. Since no reliable estimate of Primary and Secondary populations was available, the proportion obtained in the samples was used as an estimate of the population proportion and the CPS counts were adjusted accordingly.

### Parent Sample Weights

The computation of parent sample adjustment weights followed the computation of the youth's weights for the Social Influence and Parent Location modules. The parent base weight was initially set equal to the designated youth weight for these modules. If a household had more than one interviewed eligible youth (16- to 20-year-old PMS or PFS youth) in the sample, then the parent base weight was equal to the designated youth weight

multiplied by the number of interviewed eligible youths. Parent base weights were computed for all parents who responded to the survey. Nonresponse adjustments via poststratification involved adjustments by sex and education of parents, and by age, sex, and race/ethnicity of youth. Procedures for parent weight calculations for the non-core and Perception modules were the same as those for youth.

### Factors Affecting the Precision of ACOMS Sample Estimates

A large number of factors affect the precision of sample estimates. The size of the sample drawn is perhaps the most obvious factor. As sample sizes increase so does the precision of survey estimates (though not linearly). This section discusses the impact of design and unequal weighting effects on ACOMS sample precision.

#### Design Effects Due to Clustering

Departures from a SRS design such as clustering affect the variance of sample estimates. Generally the effect is to increase the variance of estimates over that which would be expected from a SRS design of equal size. Design effects are defined as

$$DEFF = \sigma^2_{\text{complex}} / \sigma^2_{\text{SRS}}$$

where  $\sigma^2_{\text{complex}}$  is the variance of a parameter estimate from a complex survey and  $\sigma^2_{\text{SRS}}$  is the corresponding variance from a SRS design. Design effects greater than 1 indicate the proportional increase in variance due to complex sample design. For example, a design effect of 1.38 means that variance estimates for a complex sample are 38% higher than those that would be obtained from a SRS of the same size.

Since ACOMS data were collected using the RDD method the ACOMS sample is a cluster sample (with the clusters being blocks of 100 telephone numbers). The relationship between the variances of cluster ( $\sigma^2_{\text{cluster}}$ ) and simple random samples ( $\sigma^2_{\text{SRS}}$ ) is given by

$$\sigma^2_{\text{cluster}} = \sigma^2_{\text{SRS}} * (1 + p(\bar{n} - 1))$$

where  $\bar{n}$  is the average number of eligible sample households per cluster and  $p$  (rho) is the intraclass correlation among households within clusters. The quantity  $(1 + p(\bar{n} - 1))$ , then, is the ACOMS design effect due to clustering.

Extensive evaluation of design effects due to clustering led to the conclusion that for the ACOMS sample this effect was minimal. The effects of clustering are determined by two factors,  $\bar{n}$  and  $p$ . If the intraclass correlation among households within clusters were .04 (a value somewhat higher than generally

observed for ACOMS) and the average number of eligible households 20, then the clustering effect would be 1.76. A design effect of this magnitude certainly cannot be ignored. In practice, however,  $\bar{n}$  was usually less than 4. This results in a design effect of approximately 1.12. Since computed clustering design effects were most often even smaller, ACOMS design effects due to clustering were considered negligible.

### Unequal Weighting Effects

Although ACOMS design effects due to clustering proved to be minimal, another design related effect did demonstrate a considerable impact on the precision of sample estimates. This is the inflation in variances due to unequal survey sample weighting adjustments (unequal weighting effect or UWE). In the ACOMS design females were selected at much lower rates than males generally and Hispanic males at rates much higher than other males. Additionally, some questionnaire modules were differentially administered to subsamples of respondents. Each of these factors contributed to large variations in sample adjustment weights. Effects due to unequal weighting were calculated as

$$UWE = \frac{N * \sum W_i^2}{(\sum W_i)^2}$$

where N is the sample size and the  $W_i$  are the weights assigned to individual respondents. Calculation of the unequal weighting effects demonstrated the large impact that differential sample selection and consequently weighting had upon the precision of ACOMS sample estimates. The interpretation of UWE is exactly the same as that for DEFF.

Table 15 shows the size of the unequal weighting effect for various sample groups.

In the majority of cases, design effects reflected expectations regarding the variability of sample adjustment weights. Total sample unequal weighting effects, for example, were higher than those for males and females alone. This is due to the homogeneity of weights for males and females relative to the total sample. For similar reasons males generally have larger design effects than females due to Hispanic male supplementation.

The relationship between precision and sample design and design related factors summarized by unequal weighting effect highlights the related concept of effective sample size. The effective sample size of a complex survey is the SRS sample size required to reproduce the same degree of precision in sample estimates. Effective sample size (ESS) is defined here as

$$ESS = \frac{\text{obtained sample size}}{UWE}$$

Table 15  
Summary of Unequal Weighting Effects

<u>Sample Group</u>	<u>Unequal Weighting Effect</u>
Youth Sample	
Total Sample	2.50
Males	1.45
Females	1.40
Questionnaire Modules (Youth)	
Core	2.50
Perceptions	
Active Army	2.60
Marines	2.10
Reserve	3.30
Social Influence	2.95
Parent Sample	
Total Sample	2.60
male Parent/Guardian	1.64
Female Parent/Guardian	1.35



where the obtained sample size is merely the N of the complex sample. If, for example, the sample N is 1,000 and the unequal weighting effect is 1.38, then the effective sample size for analysis is 725. That is, the effective sample size in terms of the precision that would be obtained from a SRS design is 725 or somewhat less than three-fourths of the obtained sample size.

### ACOMS Statistical Analyses

Most standard techniques derived for statistical analysis (i.e., those used by commonly used statistical software packages such as SAS, SPSS, and BMDP) assume that observations are independent and drawn using SRS selection methods. From these assumptions, classical statistical theory has developed a wide variety of estimators valid under these conditions. For example, for an SRS drawn without replacement, the sample mean of a continuous variable is computed using the familiar formula:

$$\bar{y} = 1/n \sum_{i=1}^n y_i$$

and variance is calculated by

$$s^2 = 1/(n-1) \sum_{i=1}^n (y_i - \bar{y})^2.$$

Once a sample design departs from SRS, however, new computational procedures are required in order to take into account design effects upon statistical estimation. If, for example, a population is stratified into L mutually exclusive groups (e.g., males and females as in ACOMS) containing  $N_1$  and  $N_2$  individuals and random samples of predetermined sizes  $n_1$  and  $n_2$  are drawn from each stratum, the standard (i.e., SRS) formulas for mean and variance become inappropriate and biased. The unbiased population mean in this case is estimated as:

$$\bar{y} = \sum_{h=1}^L w_h \bar{y}_h$$

where  $y_h$  is the mean of the  $n_h$  individuals drawn from the  $h^{\text{th}}$  stratum,  $N$  is the total size of the population, and  $w_h = N_h/N$ . An unbiased estimate of  $y$ 's variance is:

$$s^2(\bar{y}) = \sum_{h=1}^L w_h^2 (1 - f_h) s_h^2 / n_h$$

where  $s_h^2$  is the variance of variable  $y$  in the  $h^{\text{th}}$  stratum, and  $f_h = n_h/N_h$  is the sampling fraction in the  $h^{\text{th}}$  stratum.

As this example illustrates, the complexity of formulas and computations required for statistical analysis increases as sample design departs from SRS assumptions. Two other implications of complex designs for statistical analyses are worthy of mention in connection with ACOMS. First, regarding more complex statistics, in many circumstances it is extremely difficult to even derive formulas for the computation of estimates and variances. (See Cochran, 1963, for a discussion of difficulties encountered in the regression context.) Second, certain sample selection techniques are such that their effects on the precision of survey estimates cannot be established *a priori*. (See Goodman & Kish, 1950, for a discussion of the technique of controlled selection.)

Consequently, the ACOMS sample design which includes clustering, stratification, questionnaire module rotation, and differential question allocation within the Perceptions module complicates analysis. The major difficulty encountered is in the area of statistical significance testing and variance estimation. Unbiased weighted statistics (e.g., means, proportions, correlation and regression coefficients, etc.) can be produced by most contemporary statistical software packages. These same packages, however, cannot produce unbiased significance tests or variance estimates for weighted survey data.

For ACOMS analyses, two significance testing and variance estimation strategies were utilized. For contingency table analyses where chi-square tests were required, an approximate chi-square adapted from Fellegi (1980) was used. In all other circumstances, the method of balanced repeated replications (BRR) was used for variance estimation and significance testing (see McCarthy, 1966).

#### Chi-Square Approximation for Contingency Table Analysis

In order to test the statistical independence of row and column variables in a contingency table, an approximate chi-square statistic was computed. This approximation adjusted weighted estimates of table frequencies and proportions to reflect the unweighted sample size for the table and survey sample unequal weighting effects. The approximation (presented in Fellegi, 1980) was computed as:

$$t'' = \frac{1}{UWE} \sum_{i,j} \frac{(P_{ij} - P_{i.}P_{.j})^2}{P_{i.}P_{.j}} \quad (9)$$

where

- $P_{ij}$  - observed proportion for cell in row  $i$  column  $j$ ,
- $P_{i.}$  - marginal proportion for row  $i$ ,
- $P_{.j}$  - marginal proportion for column  $j$ ,
- $P_{i.}P_{.j}$  - expected proportion for cell in row  $i$  column  $j$ ,
- $UWE$  - the average unequal weighting effect for the variables  $i$  and  $j$ , and
- $t''$  is distributed approximately as chi-square.

The effect of this approximation is to compute chi-square using weighted observed and expected proportions while simultaneously adjusting the computed chi-square statistic to reflect the effective (i.e., not weighted or SRS) sample size. The computation of unequal weighting effect was accomplished using the technique discussed in the previous section of this chapter. Performance of the chi-square significance test was carried out within SAS and personal computer (PC) spreadsheet environments as convenience dictated.

#### Balanced Repeated Replication (BRR) Variance Estimation

ACOMS analyses required the production of numerous statistics (e.g., means, correlations, and regression coefficients, etc.). For contingency table analyses an approximate chi-square test was used to evaluate statistical independence. For the remaining tests of statistical significance, the BRR methodology was used.

Essentially, BRR empirically mimics the sampling distribution theory which underlies variance estimation formulas derived for SRS samples (i.e., the sampling variance that would be expected to occur were an infinite number of samples drawn from the population). The BRR methodology used the full sample statistic estimate as a benchmark and repeatedly drew half-samples (i.e., samples one-half the size of the full sample - for ACOMS, 68 half-samples were drawn) from this sample. Sample variance of the statistic (e.g., a mean, proportion, correlation coefficient, regression coefficient, etc.) were then computed as the variance of half-sample estimates about full sample estimates. Computationally, ACOMS variance estimates were obtained using the following formula:

$$s^2(e) = 1/68 \sum_{r=1}^{68} (E_r - E_f)^2 \quad (10)$$

where  $s^2(e)$  - estimated sample variance of statistic E,  
 $E_f$  - the estimated value of the statistic for  
the full sample, and  
 $E_r$  - the estimate for the  $r^{\text{th}}$  half-sample  
replicate.

As discussed, this structuring of variance estimation and significance testing has the advantage of mimicking classical sampling distribution theory and is, therefore, conceptually straightforward. Additionally, by using half-samples drawn from the complex sample, the sample design and adjustment weights are explicitly incorporated in the BRR methodology. Therefore, variance estimation and significance testing did not require the separate estimation of quantities such as design or unequal weighting effects.

"Balanced" within the context of BRR requires that the half-samples drawn for the purpose of variance estimation are uncorrelated. The ACOMS database has been structured to include variables identifying all replicate

samples formed according to this statistical requirement. In addition, the weights necessary for BRR half-sample estimation were included on the database. Directly analogous weights and samples have been established for the parental sample (the major distinction being that 32 rather than 68 half-samples are used for estimation purposes).

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